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THE GIANT BALUCHITHERE

This colossal hornless rhinoceros is represented in the 1928 collection of the Central Asiatic Expedition by the long, massive bones of the forelimb and neck. Its shoulder height was 17 feet and the browsing height of the head 27 feet, exceeding that of the tallest giraffe

See "The Revival of Central Asiatic Life"

VOLUME XXIX

NATURAL HISTORY

NUMBER ONE

JANUARY-FEBRUARY, 1929

THE REVIVAL OF CENTRAL ASIATIC LIFE

A Triumph of Modern Palæontology—New and Unexpected Light on the Life History of the Globe for the Past 155,000,000 Years—Thirty more or less Complete Vistas into the Previously Unknown Life of the Mother of Continents—Hazards and Hardships but Finally Brilliant Success of the Fourth American Expedition into the Gobi Desert

By HENRY FAIRFIELD OSBORN

Honorary Curator of Palæontology, American Museum

With Three Drawings by Margaret Flinsch Under the Direction of Henry Fairfield Osborn

REVIVAL or the bringing back to life of the plants and animals that lived on our prehistoric planet, thouands, millions, perhaps hundreds of millions of years ago, is the supreme art of the palæontologist and geologist.

This art is best practiced in a country which in the past was subject neither to the extreme luxuriance of abundant and more or less dense forests nor to the opposite extreme of aridity and sand erosion, and no section of the world seems to meet all the requirements for fossilization better than the partly uninhabitable, partly habitable, region of central Asia which formerly embraced the present Gobi desert of Mongolia.

On an 'equal area' map (see page 4) we observe that the very old continent of Asia has a commanding position as the center of our planet; that Europe is a mere western outlier of this great Asiatic land mass; that even Africa appears as a giant appendage or peninsula to the far southwest; and that our own North America, with South America as an appendage, takes on the form of a large eastern peninsula.

Since Asia is truly the central continent, the fertile mother of all the other continents, and since its environmental conditions favor the preservation in fossil form of its life down the ages, how transcendentaly important becomes the revival of central Asiatic life! It is to this revival that the Central Asiatic Expeditions of the American Museum are devoted. The great outstanding result of the exploration and research under Roy Chapman Andrews, Walter Granger, Charles P. Berkey, and their gallant colleagues is that the most terrible desert of the entire world has been restored and revivified into the very Garden of Eden of the period of the reptilian and mammalian creations. In the rela-

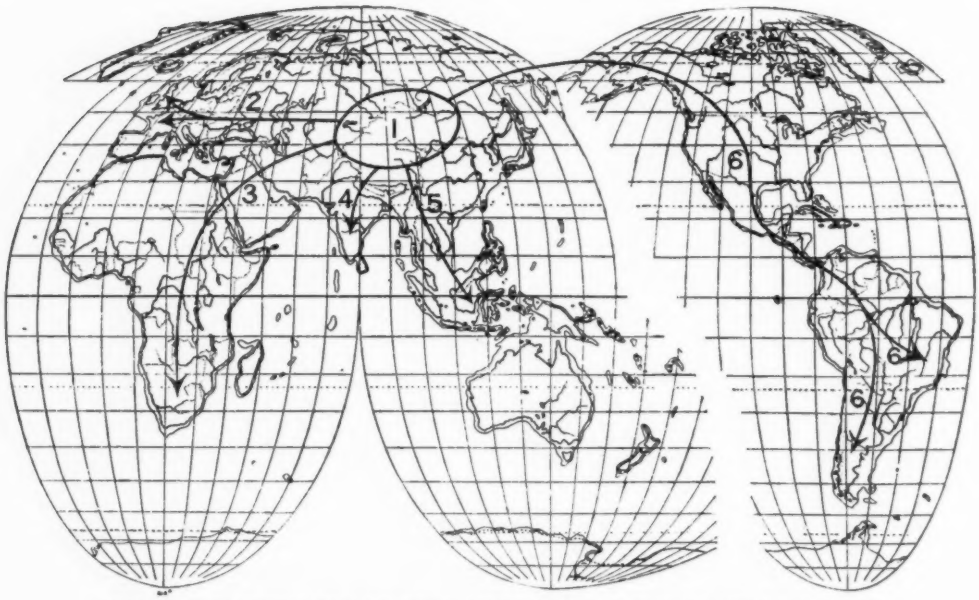


DIAGRAM SHOWING WORLD-WIDE MIGRATION OF THE GIANT DINOSAURS

(1) Central Asia, mother of continents, fertile center of life for 155,000,000 years, from which migrated waves of reptilian life into (2) western Europe, (3) the extremity of Africa, (4) the peninsula of India, (5) China and the East Indies, (6, 6, 6) North and South America. This diagram represents the actually known migrations and world-wide expansion of the giant dinosaurs known as Sauropoda, of Upper Jurassic time. These same migration routes were subsequently followed by many orders and families of mammals which chiefly originated in central Asia

tively brief period of six years between 1922 and 1928, the Central Asiatic Expeditions of the American Museum have fairly revived this sleeping giant of prehistory, as well as the outstanding events of its majestic life history during the geologic period now estimated by geologists and physicists at upward of 155,000,000 years, subdivided into the following time epochs:

AGE OF MAN			
Recent and Pleistocene time	1,000,000	Man, Giant Ostriches	Gochu, Tsagan Nuru, Orok Nor, Shabarakh Usu
AGE OF MAMMALS			
Pliocene time	6,000,000	Horses, Camels from America	Hung Kureh, Tung Gur
Miocene time	12,000,000	Mastodonts from Africa	Loh
Oligocene time	16,000,000	Giant Titanotheres and Baluchitheres	Ardyn Obo, Ulan Gochu, Houldjin, Hsanda Gol.
Eocene time	20,000,000	Mammals akin to those of the Rocky Mt. region	Gashato, Kolobolchi, Irden Manha, Shara Murun
AGE OF REPTILES			
Upper Cretaceous	40,000,000	Closing Age of Dinosaurs	Djadokhta
Lower Cretaceous	25,000,000	Various Iguanodont Dinosaurs	Iren Dabasu
Jurassic	35,000,000	Giant Sauropod Dinosaurs	Ondai Sair, Ashile

From first to last this central region of Asia has been the homeland of waves of migrating plants, land reptiles, and mammals that successively spread over every continent along the general lines indicated in the map on page 4. Beginning in Jurassic time and accompanying the massive tread of the giant sauropods to the very extremes of South Africa and South America were the scions of hosts of other kinds of dinosaurs, such as the leaf-eating iguanodonts and the smaller and larger carnivorous dinosaurs known as megalosaurs or theropods. At the close of Cretaceous time, when the iguanodonts and related Ceratopsians, now famous for their nests of eggs, and the dire large and small carnivorous enemies of both these herbivorous dinosaurs, passed away, there followed in Eocene time a successive creation and evolution of smaller and larger types of mammals, which culminated successively in giant titanotheres, in overpowering Baluchitheres of the Oligocene, and finally in several kinds of mastodonts, including the recently discovered 'shovel tusker' and 'serrate toothed' mastodon (*Serridentinus*). These mastodont proboscideans, however, were not of central Asiatic origin—they were invaders from the African or Ethiopian region passing through central Asia on their long trek into Europe, southern Asia, North and South America.

These successive waves of life, these arrivals and departures, these competitions and expansions of the older and newer dynasties of the animal kingdom are revealed in part in the rocks of upwards of thirty 'horizons' or 'life zones' to which our geologists have uniformly applied local Mongolian names—for example, 'Irden Manha', 'Valley of the Jewels'—from which we are granted occasional vistas into the long corridors of central Asiatic time. Twenty-one of these palæontological vistas, discovered in the years 1922, 1923, and 1925, have already been defined.[1] Two wartime years in China intervened, and now the year 1928

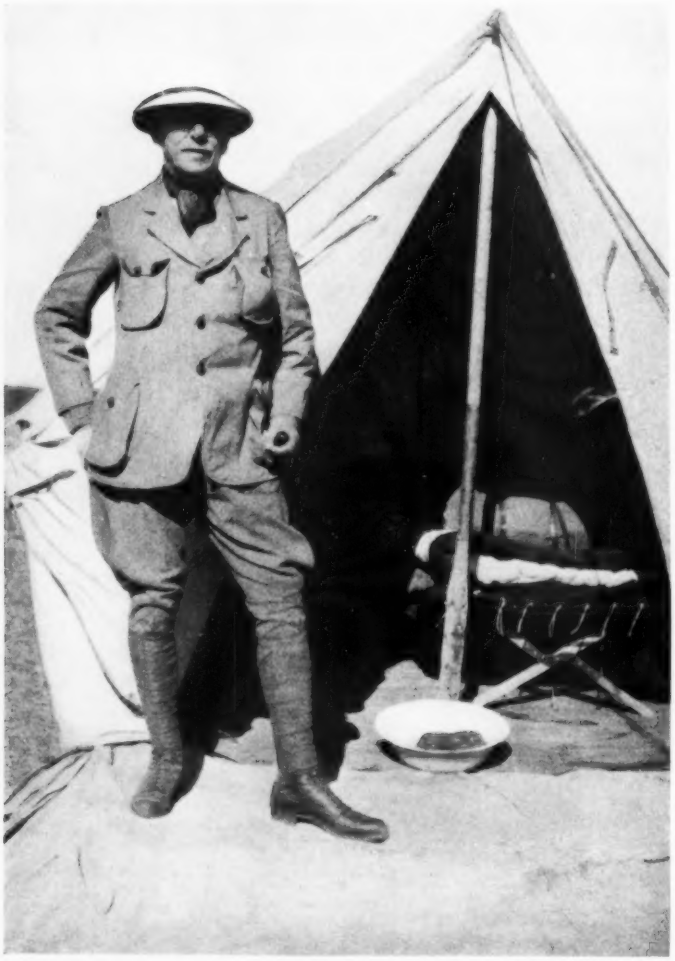
[1]See Mongolia, Enc. Brit., 13th ed. supp. By H. F. Osborn

SURVEYING THE BADLANDS OF URTYN OBO
Tserin, trusty Mongol leader of the camel caravan, is gazing across these badlands, which appear exactly like those of Montana and Dakota

adds several new vistas into the previously unexplored Pliocene time and reveals new and stupendous forms of mammalian life.

THE BREAK BETWEEN THE GOBI AND THE ROCKY MOUNTAIN REGION

Immediately following the Lower Oligocene horizon of Ardyn Obo, and bringing to a close the long-continued friendly interchange and migration of fossil reptilian and mammalian life between the Gobi Desert and our Rocky Mountain region, there occurred a momentous break in the amicable international relations between central Asia and North America that had endured almost continuously for 120,000,000 years. The cause of this break was probably geographic as well as climatic and environmental. From this time on until the end of Pliocene time, North America pursued its own way in uninterrupted evolution of the quadruped stocks which it had originally received from central Asia and the unexplored regions north of central Asia; it became especially the home of a great variety of horses and camels which, it is important to note, *were previously unknown in central Asia up to the time of the break between the life of the two continents.* Toward the close of Pliocene time new waves of south Asiatic and African life again entered North America, followed by the final wave near the close of the Ice Age which gave North America its present mammals, the bison, deer, and bear.



PROFESSOR OSBORN IN CAMP AT IRDEN MANHA
It was here that the titanotheres were first discovered

After this important Upper Oligocene break with North America there followed in the Gobi region of central Asia the most favorable climatic and environmental conditions that the mammalian kingdom has ever enjoyed, not excepting the highly propitious conditions of the modern equatorial African uplands. Under these favorable conditions of fertile and relatively well-watered uplands and broad level plains, of partly meandering streams bordered with forests and

AMERICAN MUSEUM CAMP AND WORKINGS AT CHILIAN HOTOGA
In the New Stone Age deposits of Chilian Hotoga were discovered teeth and bones that had been fashioned into artifacts by man

succulent vegetation, there arose new races of quadrupeds surpassing in size and grandeur even the great titanotheres of America hitherto known, or the great mammoths that in northern Africa and in southern Eurasia marked the close of the Age of Mammals and the beginning of the Age of Man. These new monarchs of the central Asiatic plateaus were partly endemic or native and partly migrant from Africa. They were offshoots of three entirely distinct families, namely, first, the Baluchitheres or giant hornless rhinoceroses; second, the giant bony-horned quadrupeds first discovered in America and known as titanotheres; third, the shovel-tusked mastodonts, a branch of long-jawed proboscideans.

These giants were not contemporaneous; they succeeded each other geologically as follows:

FIRST: Titanotheres, of Lower Oligocene age. Whereas in the Rocky Mountain region titanotheres reached their climax in the giant pair-horned *Brontotherium platyceras* of the Lower Oligocene, they survived and attained a superclimax in the still larger and more unique battering-ram-nosed *Embolotherium* (Greek ἐμβολή, signifying 'a battering ram') of the Oligocene of the Desert of Gobi. This animal somewhat exceeds in size the largest *Brontotherium* ('flat-horned thunder beast') of North America and develops in the front part of its face an entirely novel nasal battering ram composed of combined nasal and frontal bones. As the 'brontotherium' used its horns in tossing, the 'embolothere' used its horns for battering, assaulting, attacking, charging, and tossing. This bony horn rose 28 inches in the very front part of the face and was broadly expanded at the summit (Page 14). Roy Chapman Andrews informs us (August 22, 1928) that the ram-nosed titanotheres "are from the Ulan Gochu region, probably Middle Oligocene, and belong to the same group as the front portion of the skull found in the Shara Murun by Harold Loucks in 1925, although the new skulls are much larger than the Loucks specimen and are comparable to the largest of our American Oligocene titanotheres. There are no true horns but the frontal and nasal bones are produced upwards and terminate in a transversely broad blunt and rugose end. Fully as impressive as our finest American skulls, they surely represent a distinct phylum of titanothere."

SECOND: Baluchitheres, of Upper Oligocene age, including the *Baluchitherium*, named because of its original discovery in Baluchistan; also represented in *Indricotherium* of Turkestan and in

EXCAVATING THE TITANOTHERE BONES
Professor Osborn and Walter Granger, assistant leader of the expedition, examining the titanothere jaw exposed at Irden Manha

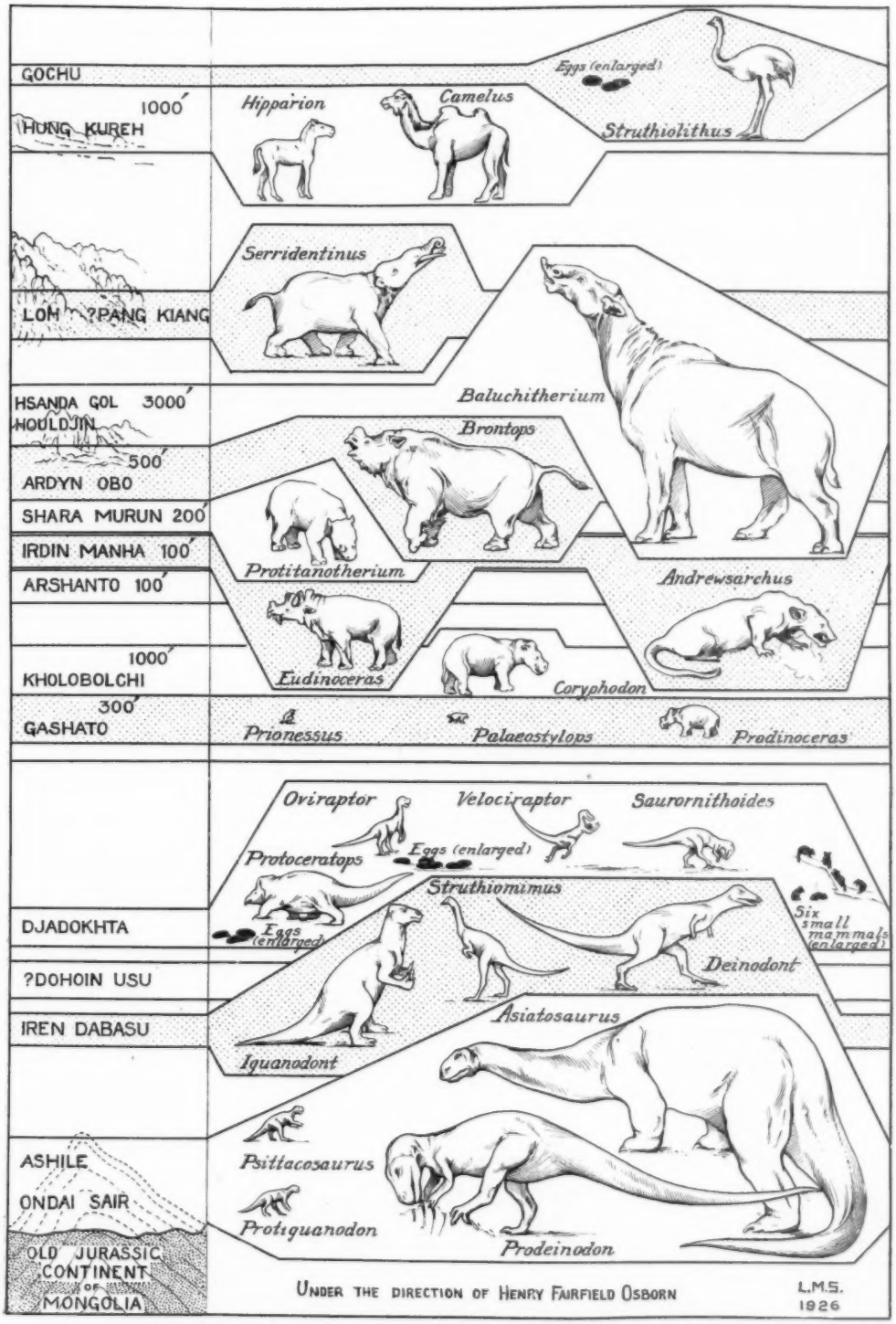
Baluchitherium grangeri of the Upper Oligocene Hsanda Gol and Houldjin horizons of the Gobi. Discovered by the 1928 expedition is the still more gigantic stage fabulously known in the American press as the 'Woolworth' among mammals. This hornless rhinoceros is thus far unknown except in the Oligocene and Miocene of central and southern Asia.

THIRD: Shovel-tusked Amebelodonts, of Pliocene age. Of less imposing size than the Baluchitheres or the battering-ram-nosed titanotheres, but of still more bizarre adaptation, are the shovel-tusked mastodonts, the direct ancestry of which can be traced back to the relatively small Oligocene shovel-tusker known as *Phiomia osborni* which frequented the ancient river Nile, the 'Ur-Nile' as it has been called, of the Fayûm region of northern Africa. The dramatic discovery of these animals is fully described below.

DISCOVERY OF THE GIANT SHOVEL-TUSKER

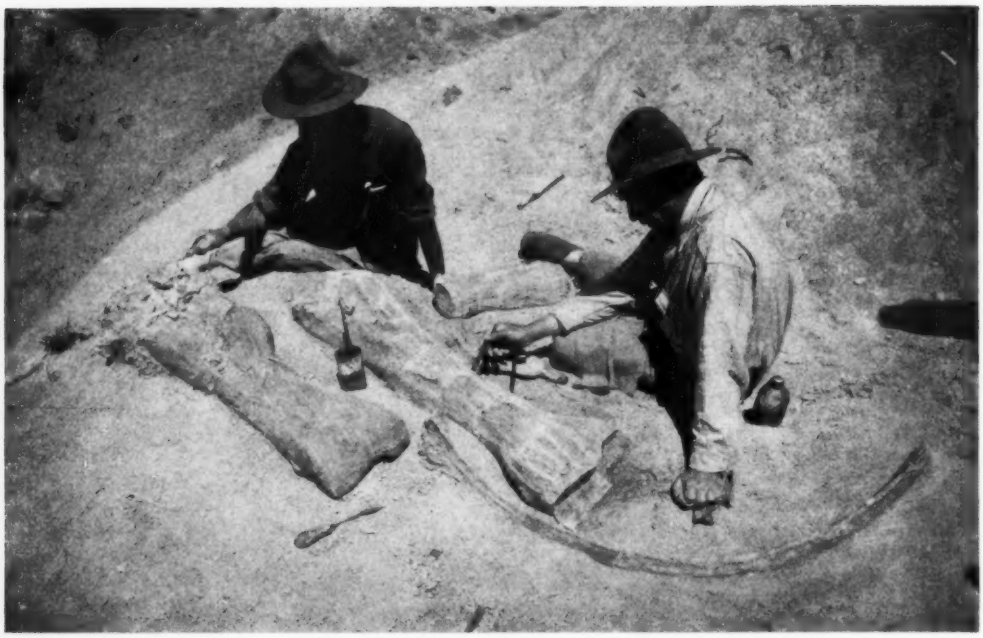
The leader of our expedition reported the sites of more than one of the 1928 camps as very rich localities, in which "great new areas of exposures have been discovered, a good deal of *Baluchitherium* turned up, besides three skulls of that extraordinary titanothere with the clubbed nasals that Doctor Loucks found, many 'Dune-Dweller' artifacts and some of a type entirely new to Pond, [our archæologist], and many other good things." He considered these sites worthy of a whole season's research. Despite this, the season of 1928 was one of extreme difficulty and threatened until the very end to be entirely unproductive of results.

Our dauntless explorers are very stoical regarding their hardships and disappointments; none but the most extreme difficulties are even alluded to. Northwest of the Ordos, occured the most critical time in the whole series of our Central Asiatic Expeditions since 1922; no discovery of transcendent importance having been made, weather conditions being the worst our expeditions had ever encountered, the leader suffering from a painful and threat-



155,000,000-YEAR LIFE SUCCESSION OF THE GOBI SINCE THE JURASSIC

On each ascending geologic level are portrayed the dominant life forms discovered in successive ascending horizons, beginning with the giant sauropod *Asiatosaurus* of the Upper Jurassic and ending with the horse, camel, and ostrich of the human period (restorations mostly to the same scale of size). It will be observed that each geologic stage has its giant form of life, but never do two giant forms occur in the same period; it will also be observed that there is steady progress from the very humid environment adapted to *Asiatosaurus* to the very arid environment adapted to the bactrian camel (*Camelus*) and the ostrich (*Struthiolithus*)



MEASURING THE LEG BONE OF THE "MONSTER"
Chief Andrews and Assistant Chief Granger uncovering giant forelimb of the new colossal species of *Baluchitherium*, chief trophy of the expedition of 1928

HEROIC LEADERS OF THE EXPEDITION OF 1928
Left to right they are, lower row: Perez, Andrews (chief), Granger (assistant chief), Spock (archæologist), Thomson (palæontologist); upper row: Shackelford, Pond, Eriksson, Horwath, Young, and Hill

TAKING OUT DINOSAUR EGGS

New deposit of dinosaur eggs discovered near the Kalgan-Urga trail at Ehrlein being unearthed by Roy Chapman Andrews and Walter Granger

CHIEF TROPHY OF THE 1923 EXPEDITION

The finding of several nests of dinosaur eggs during 1923 was the first positive proof that some dinosaurs laid eggs

ening wound and receiving surgical care under the most trying conditions, the western way to Chinese Turkestan absolutely blocked by mountains of driven sand, the party discouraged by the return of Sven Hedin's decimated and half-starved caravan—such were the conditions which roused afresh the fighting spirit of Andrews, Granger, and Young, and led to the practical reversal of matured plans and to an entirely new plan of campaign which involved retiring from the western post and turning eastward and northeastward.

The palæontologist always takes a gambler's chance, but fossil gambling in a country so many parts of which had yielded rich returns is so full of promise that we can well understand the renewed outburst of optimism on the part of our explorers even in the midst of their leader's acute physical distress. Thus with the face of the caravans and of the motor trucks turned toward the northeast, the expedition crossed the line of the Kalgan-Urga trail at the telegraph station of Ehrlein and slowly worked northeastward, to be rewarded early in August by the discovery of extensive exposures of Pliocene age, 24 to 130 miles east of Iren Dabasu.

It was the enforced end of the collecting season; the gasoline supply was running very low, for owing to the frightful heat of May and June in the western part of the Gobi more than one-third of the cans had exploded, and our reconnoitering party had come to their last evening before facing southward toward Kalgan for the return journey. On his way to the summit of a high bluff on which were stretched the American Museum tents, Walter Granger suddenly struck his foot against a slight projection; even in the gathering twilight it seemed on close examination to be a fossil. Marking the spot, he hastened back to camp and said:

"Roy, we cannot move tomorrow morning; I think I have found something entirely new."

Hurrying down the bluff soon after dawn, they exposed carefully what proved to be a complete lower jaw, eight feet in length, very slender in the middle portion and expanding in front into the most astounding pair of lower teeth fourteen inches in breadth!

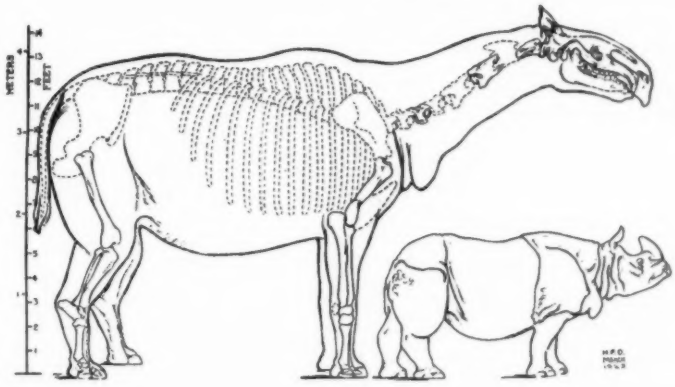
The jaw was that of a giant shoveltusker (Page 15). The two lower teeth are closely pressed together in the middle line, broadened and flattened at the sides, so that together they exceed the dimensions of

Wide geographic range of the giant hornless Baluchithere belonging to different species in (1) Baluchistan, (2) Turkestan, (3, 4) Central Mongolia

the typical Irishman's shovel. In place of the shovel handle is the long, relatively slender lower jaw by which the shovel tusks were pushed into the sand or, more probably, used to uproot nutritious tubers. Of the brilliant Gobi discovery which occurred at the very end of the 1928 season in Pliocene beds of eastern Mongolia, Roy Chapman Andrews writes, August 22, 1928:

> We have one specimen of the lower jaw in which the front is well preserved. The incisor teeth are about one inch in thickness, seven inches in transversal breadth and over a foot in length and truncated at the wearing end. The alveolar border comes directly to the front edge of the teeth on the under side but on the lingual surface the teeth are bare for several inches back of the cutting edge. The symphysis is broadest some distance back of the front and is rather deeply concave. It suggests a spoon which has been cut squarely across in front. Back of the symphysis the jaws seem to be of a more normal mastodont type. This mastodont comes from Pliocene beds to the eastward of the Kalgan-Urga trail and it may be that Père Teilhard got traces of it when he explored the Talai Nor region in 1924, but it is entirely new to me.

Above.—The giant Baluchithere, chief trophy of the American Museum Expedition of 1927. After restoration by C. R. Knight. This record-breaking species now yields in size to the 'colossus' of 1828



Left.—Colossal scale of the giant Baluchithere of 1927 as compared with a full-grown Indian rhinoceros

This unique type of mastodont was first described by Prof. Erwin H. Barbour from a fossil jaw which he found in western Nebraska and to which he applied the

THE NEW BATTERING-RAM TITANOTHERE

It has been named *Embolotherium andrewsi* in honor of the leader of the expedition. This is a giant survivor of the great race of qaudrupeds that roamed from the Balkans across Eurasia into Nebraska and Colorado. The position of the nostril opening is problematic.

THE GIANT SHOVEL-TUSKER

A new species of mastodont named *Amebelodon grangeri*, a descendant of the primitive long-jawed mastodont (*Phiomia*) of northern Africa. Adapted to uprooting bulbous plants, it frequented the shallow lake waters of ancient Gobi

highly appropriate generic name *Amebelodon* (derived from two Greek words signifying 'shovel' and 'end-tooth'). The Gobi discovery, which may be named *Amebelodon grangeri* confirms in the most surprising manner the adaptation so aptly named by Professor Barbour, and it demonstrates, as in the case of all the other quadrupeds, that the Gobi climate and environment were even more favorable than that of the Nebraska plains in Pliocene time, because in the Gobi shovel-tusker the dimensions are nearly double those of the Nebraska shovel-tusker.

But central Asia is still reluctant to yield completely to the supreme art of the palæontologist and geologist the most important fossil mammal of all, namely, the ancestors of the Dawn Man, which still elude discovery. When found, the Dawn Man, a biped living in a partly open country, will be quite distinguishable from the anthropoid apes, which lived in the tropical forests of India to the far south. Andrews and Granger have been foiled this year in finding traces of the ancestry of man in Oligocene or Miocene time. This was to have been expected, because the coarse gravel and sand deposits which contained the giant quadrupeds unearthed by the expedition are not favorable to the preservation of the more delicate remains of the ancestral Dawn Man or of the anthropoid apes.

Finally, during this period of the triumphant revival of central Asiatic life, may we not conclude this preliminary and all too brief outline with the prophetic vision of Isaiah?

The wilderness and the dry land shall be glad; and the desert shall rejoice, and blossom as the rose. It shall blossom abundantly and rejoice, even with joy and singing; . . . for in the wilderness shall waters break out, and streams in the desert. And the glowing sand shall become a pool, and the thirsty ground springs of water.

ISAIAH 35: 1–7.

UNEARTHING THE BATTERING-RAM-NOSED TITANOTHERE *Embolotherium andrewsi*, ONE OF THE THREE GREAT TROPHIES OF THE EXPEDITION OF 1928. THE FRONT ASPECT OF THE 28-INCH NASAL FRONTAL HORN APPEARS IN THIS PHOTOGRAPH. THE PHOTOGRAPH OF MR. GRANGER GIVES THE SCALE

Courtesy of Northern Pacific Railway Co

Paradise Inn, Rainier National Park, in May

WHEN WINTER COMES

The Many Forms Taken by Frozen Water—
Snow and Ice—Sleet and Hail—
Glaze and Hoar Frost

By CHESTER A. REEDS

Curator of Geology, American Museum

With Photographs of Snow Crystals by W. A. Bentley

EVERY winter the varied forms of frozen water, such as frost, rime, glaze, sleet, snow, and ice, afford not only the most pleasing sights, but they display natural phenomena that are of intense interest to everyone. All of the forms are exquisitely beautiful and worthy of the study of the most gifted scholars.

It may be noted that as autumn passes into winter there is a gradual lowering of the average temperature, and during clear nights the radiation from the ground may produce a temporary decrease of temperature of the land below the freezing point of water, although the general mass of the air above remains at a higher temperature. Under such circumstances the water vapor in the lower layers of the atmosphere condenses and, as it settles upon the cold objects on the ground, it freezes and forms a light feathery deposit of ice known as *hoar-frost*. The heaviest hoar-frosts are formed under weather conditions similar to those under which the heaviest summer dews occur, namely: clear and calm nights, when there is no cloud or smoke layer to impede the radiation of heat from the surface of the land, which thereby becomes rapidly and completely cooled. Hoar-frosts provide one of the prettiest sights of winter, forming every conceivable pattern on the grasses, shrubs and trees, as well as the more unsightly objects, such as fences, railings, and telegraph wires. Hoar-frost is beautiful in that it presents a tracery of glittering whiteness, the result of the reflections and refractions from the small transparent spicules of ice which form the flower-like crystals.

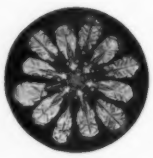
Another well-known form of frost closely allied to hoar-frost is the crystal-

Courtesy of Northern Pacific Railway Co.

MOUNT RAINIER, WASHINGTON, CLAD IN ITS WINTER COAT

Mount Rainier is one of the highest perpetually snow-capped mountains in the United States, 14,408 feet above sea level. At Paradise Inn, 5500 feet, 789.5 inches of snow fell in the winter of 1916-1917. There are twenty-eight glaciers on the slopes of this mountain, seven of them being "live," and moving at the rate of sixteen to twenty inches a day

line deposit seen when the moisture in the air of a warm room condenses on the window pane that has been cooled by contact with the cold winter air outside. These frost patterns are a joy to everyone. Not only are these feathery and fernlike forms so intrinsically beautiful in themselves, but they are highly instructive. They are usually developed by rapid labile (shifting) crystallization; sometimes by a slower crystallization, when the ends of the branches show beginnings of definite crystals of hexagonal symmetry as may be noted on the illustration from Mount Washington, New Hampshire, page 20.



Another interesting frost-like deposit of ice is known as *rime*. It may be several inches thick on the windward side of exposed objects since it is formed from undercooled fog particles and hence grows straight into the wind. It appears when a frosty fog is accompanied by wind, the fog drifting along and depositing spicules of ice on all surfaces exposed to it.

For the deposition of the rime it is essential that all surfaces be cooled by radiation below 32° Fahrenheit. As frost fogs in low-lying districts occur usually in calm weather, rime crystals are not often observed there, but are of frequent occurrence on hills, where the driving mists cover all projecting objects such as trees, fences, stones, et cetera, with great masses of loose feathery crystals of considerable thickness. When the sunlight appears, the objects of the familiar landscape appear as if dressed in garments made of closely studded diamonds. Close examination, however, reveals that

they are encrusted with ice-crystals of unusually large size, some an inch long. The exquisite splendor of such a scene endures but for a short time, for the very light rays which produce so wonderful a spectacle carry with them the heat rays which melt the crystals and destroy the remarkable sight.

In 1920 V. Bjerknes of Norway showed that when warm winds converge toward colder winds, the warm air rises above the colder air, and its moisture is condensed in the same way as in the air rising over mountain summits. Whether it be on mountain-side or on the slopes of a cold current, as soon as the warm moisture-laden and expanding air is chilled to the point of condensation, cloud formation begins and rain falls when the air reaches the point of saturation. When such a rain falls through a surface layer of air cooled to below the freezing point, the raindrops freeze on touching cold solid objects and form a smooth coating of ice on the ground, trees, fences, et cetera, known as *glaze*. These ice storms are not uncommon in the United States and Europe.

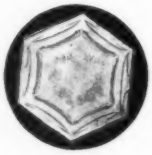
In 1920 C. LeRoy Meisinger, of the United States Weather Bureau, by using records from kites and balloons, traced out the manner in which warm southerly winds overflowing cold winds from the north produced zones of rain, glaze, sleet, and snow. Often such storms are local and do not have a widespread effect, but once or twice in a winter they may occur over a large area. The ice storm that passed over Philadelphia and Baltimore at the time of President Taft's inauguration, March 4, 1909, may be cited as an example. The ice that formed

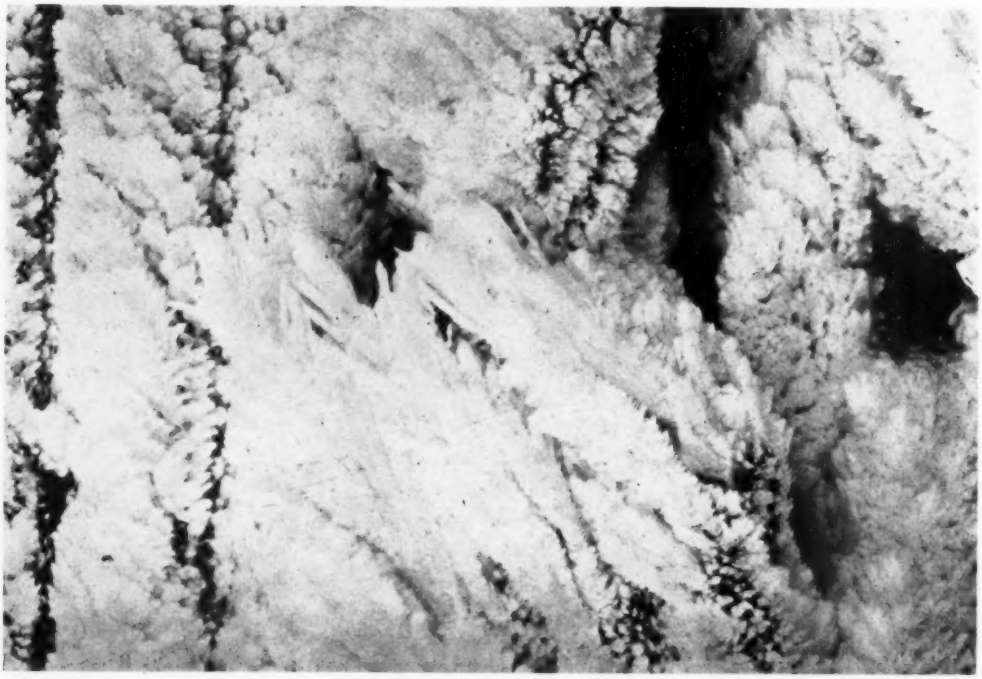
NIAGARA FALLS IN THE DEPTH OF WINTER
During the month of February the spray below the Falls freezes, and gradually the front of this natural wonder is encased in snow and ice.

on the telegraph wires was so thick and heavy that many a wire and pole were broken down by the weight of it. Telegraph communications were so badly interrupted at that time that trains could not proceed for many hours.

In the winter of 1919–1920 two ice storms of this type stand out prominently —one, January 20–25, covered practically all of the territory east of the 100th meridian, while a second, February 3–6, was confined to the Atlantic coast. The great precipitation consisted of snow in the northern portions, and of snow, sleet, and rain in the middle latitudes, which formed a solid, slow-melting cover. In both instances traffic on railroads and in cities was impeded and in many places completely tied up, and telephone and telegraph lines were crippled and numerous accidents resulted. In New York City the streets were more effectually blockaded by snow than at any other time in the city's history. The removal of the snow from the streets was a difficult problem, since layers of ice had formed at different levels in the snow, increasing the rigidity of the drifts and packing them more solidly.

A form of ice which falls from the free air and produces a rattling sound when it strikes hard objects, such as a window pane or a tin roof, is known as *sleet*. It consists of partly melted snow or rain particles which freeze while falling from a warm layer of air through a cold one. Sleet is frequently driven by the wind, and it may be said that sleet falls are usually coincident with, imme-





FROST FEATHERS ON WINDOW PANE, MOUNT WASHINGTON, NEW HAMPSHIRE
The moisture of an inhabited room, coming in contact with the cold surface of a window pane, is often frozen into fantastic and beautiful designs

diately precede, or follow snowfalls. The occurrence of sleet is also known to be associated with the conditions of the atmosphere under which glaze is formed.

Another form of ice which falls from the air is known as *hail*. It consists of pellets, or hailstones, which frequently consist of a kernel of hard snow in the center, surrounded by alternate concentric layers of ice and snow; in other cases they have a radial structure. They assume various shapes, most commonly spheroidal, but some are pyramidal, others flat, and others irregularly oval. In size they usually vary from a tenth to a quarter of an inch in diameter, but masses measuring from twelve to fifteen inches in circumference and weighing more than half a pound are of occasional occurrence. The fall of hail occurs chiefly in spring and summer, and most commonly precedes or accompanies a thunderstorm. The time of its continuance is always short, generally only a few minutes. It is now believed that the continued retention and repeated elevation in the atmosphere, of a pellet initially small, which is several times carried by strong convection currents through successive regions of rain and snow, gives the requisite length of time for the accretion of the larger hailstones. Hailstones frequently damage fruit and grain crops, kill small animals, such as birds and rabbits, and occasionally cattle.

HOAR FROST ON TREES IN WINTER, NIAGARA FALLS, NEW YORK
Frost is formed when dew collects and freezes during a drop in temperature

The most common of the free air winter visitors is *snow*. It falls to the earth in flakes, each flake consisting of a distinct crystal, or more commonly, of combinations of separate crystals. The crystals are generally in the form of thin tabular plates, long needles, or columnar particles of ice formed in the air at temperatures below freezing. All are hexagonal in type, but of endless variety in detail. Many of the forms are exquisitely beautiful. The whiteness of snow is due primarily to the large numbers of reflecting surfaces arising from the minuteness of

the crystal particles.

Snow crystals are formed at high altitudes directly from the water vapor of the free atmosphere. The snow crystal solidifying as it does from the vapor of the cold upper air without passing through the liquid stage, is formed under circumstances exceptionally favorable to freedom of movement of the molecules. This fact, no doubt, accounts for the great variety of crystal forms observed, a variety not approached by any other mineral.

Mr. Wilson A. Bentley of Jerico, Vermont, has made more than 4200 exquisite photographs of snowflakes, no two of which are alike. Even when formed under identical conditions, he states, hexagonal, trigonal, oblong plate forms, six-petalled forms and columnar forms, have all been found side by side. They are mostly of six-rayed stellate form, the rays being inclined at exactly 60°, the feathery form being produced by the main six rays developing off-shoots or branches to right and left at 60°. Many of them are like stars, the interspaces between the rays of which are almost filled in with exquisite lacework. The most perfect and largest of these stellate snowflakes are formed when the air is still, the moisture plentiful, and the temperature only moderately low; the columnar, tabular, and more complete solid crystals are produced at higher altitudes in a more intense cold. Reproductions of a number of Mr. Bentley's photomicrographs of snow crystals accompany this article. They show a considerable variety of crystal forms.

According to Dr. E. T. Wherry, 1920, the nucleus from which the growth of a snow crystal starts consists of a single ice

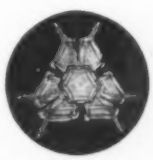
SCENE IN BALTIMORE, MARYLAND, DURING THE ICE STORM OF MARCH 4, 1909
The forecaster had predicted fair weather for President-elect Taft's inauguration at Washington, but due to the unexpected appearance of a cold air current from the north, glaze was deposited on trees and telegraph lines. For want of a better term, the storm was called a "flareback"

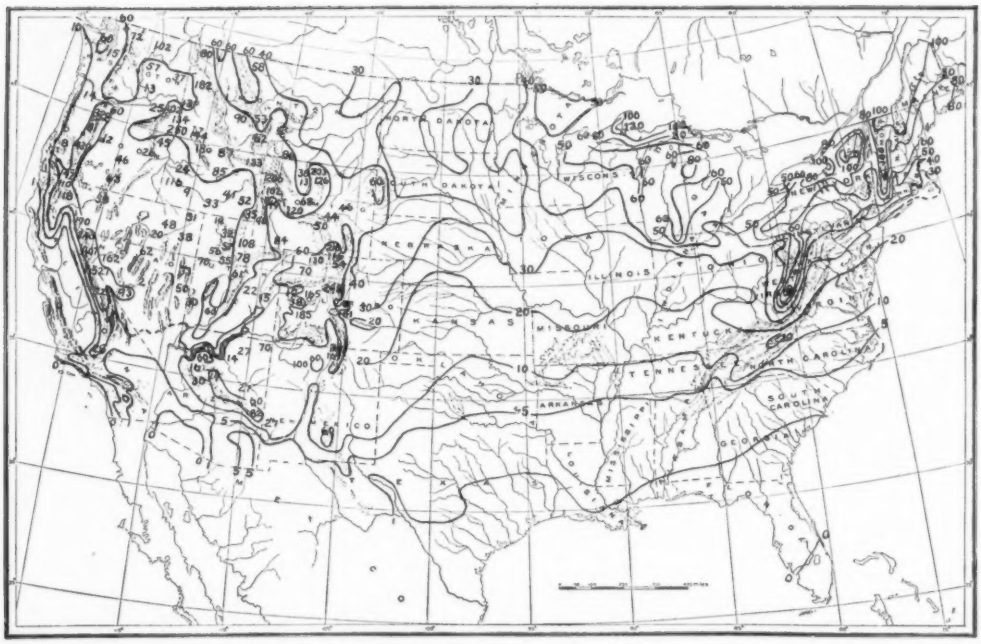
A CONNECTICUT LAWN IN WINTER
The summer house, trees, and ground are covered with sparkling ice called glaze. This winter phenomenon is particularly troublesome to railroads

molecule, which, as is indicated by the chemical evidence, consists of a group of four molecules of water (H_2O). As new material builds up around this nucleus, several different things may happen. If the growth is very gradual, relatively uninterrupted, and long continued, the crystal may retain the form of the nucleus throughout its development. Where conditions favor rapid growth, crystals in general tend to become elongated and needle-like, and when the growth occurs in several directions around an axis of symmetry, a skeleton crystal or a solid form will be produced. In snow crystals such rapid growth takes place in the directions of the three interchangeable crystal axes, or, counting from the center, in six directions, producing highly perfect hexagonal symmetry.

There is much evidence at hand to show that true snow crystals are formed directly from the minute invisible molecules of water vapor in the air, and not from the cloud particles. Some snow crystals, however, are composed of flakes coated with granular ice. These coatings are in all probability formed by the freezing of actual minute droplets of condensed water, the material of clouds. Occasionally too, lines of secondary growth in snowflakes exhibit bilateral instead of hexagonal symmetry. This is one of the unsolved problems connected with the crystal forms of snow. Other degrees of symmetry are occasionally shown by snow crystals as the result of more or less accidental conditions of growth.

In some snow crystals tabular plates of different size and outline may be developed at opposite ends of a central column as shown on page 32. Occasionally a twelve-rayed crystal may be observed. It is like the above with





SNOWFALL MAP OF THE UNITED STATES

The snowfalls for the years 1895-1914 have been averaged, and the results entered on the above map. Depths in inches. Data from Chart XVII, *Monthly Weather Review*, Washington, October, 1919

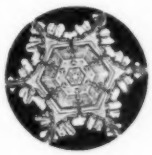
one of the two basal planes rotated 30° on a short axis without disruption. By noting the difference in development of the alternate rays one may differentiate the two phases of such a crystal.

Snowflakes vary in size from microscopic forms to those 10 cm. in diameter or larger. In most snowflakes the three horizontal axes are more fully developed than the vertical axis, and the margin of the flakes are not infrequently turned upward slightly so that they resemble a round or oval dish. The edges are turned upward slightly by reason of the resistance offered by the air in their fall. During flight they may rock to this side or that, but as a rule they do not turn over. The larger crystals have been observed to fall at the beginning of a snowfall, when the ground temperature was but a little above freezing.

The forms of snow crystals are rarely noticed during a snow storm. It is only when it is just beginning to snow in calm air and when the crystals fall on dark objects that their shapes may be distinctly recognized. This stage is the most favorable for photomicrographic work. It is usually a brief period, however, for as the crystals become more numerous they frequently reach the ground in a damaged state due to their collisions one with the other on their downward flight. As the fall of snow becomes denser, a number of crystals combine to form a conglomerate composed of crystal fragments. This is by far the most frequent form of snow in our snow storms.

The character of the snowfall also depends on its water content. The large flaked "wet" snow that falls at temperatures above freezing and usually melts rapidly, should be contrasted with the "dry," "powdery" snow that does not pack.

It not infrequently happens that rain and snow may fall simultaneously, producing *graupel*, an opaque mass of snow and water resembling soft hail. Not infrequently these have the appearance of small pellets of snow, which are readily pulverized.



Snow, especially the deep snows which lie for weeks and months on the mountains and plateaus, has an economic significance somewhat different from that of rain. The snow furnishes a slower, and therefore a more lasting natural supply of water for power, for irrigation and general use than does rain, which has a quick run-off. In the drier sections of the United States many of the engineering and agricultural problems are connected with the depth and conditions of snowfall, and the amount of water which its melting will supply. This is especially true in the mountainous sections of California, Nevada, Arizona, and the Rocky Mountain states. A winter snow cover prevents deep freezing of the ground; protects grasses and fall sown crops, and provides spring moisture for growing vegetation. This is especially true of the Missouri and upper Mississippi valley states. While snow facilitates lumbering operations in the western, northern, and northeastern states, it seriously interferes with the operation of steam and electric railways and involves great expense in its removal where city streets are covered to considerable depths.

A snowfall map of the United States, prepared by the United States Weather Bureau, is shown on page 24. It represents the average annual snowfall for the years 1895 to 1914. In examining the map it should be recalled that the amount of snowfall varies greatly and very

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ICE-INCRUSTED STEAMER, SOO LOCKS, SAULT SAINTE MARIE, MICHIGAN

Winter comes early and ends late on the upper Great Lakes. Nevertheless, more cargo tonnage (iron ore, coal, grain) passes through these locks than crosses the Atlantic between North America and Europe

irregularly from year to year. This variability depends on the length and the severity of the winter, the number and intensity of the snow storms, the temperature, the topography, proximity to primary sources of moisture-supply, such as the oceans and Great Lakes, and the exposure to damp winds.

The heaviest snowfalls in the United States occur on the western slope of the Sierra Nevada and Cascade ranges, where snowfalls amounting to more than 400 inches annually are not uncommon. Although these mountains are regions of heavy rainfall and excessive snowfall, they are not perpetually covered with snow. On many of the higher peaks the snow disappears in May or June and usually does not reappear until October. The average annual snowfall at Fordyce Dam, California, (6500 feet), for 16 years, is 402.4 inches; the average at Summit, California, (7017 feet), for 44 years, is 419.6 inches; and the average for eight years at Tamarack, California, (8000 feet), is 521.3 inches. The maximum snowfalls recorded at Summit, California, occurred in the years 1879–80, 783 inches, and 1889–90, 776 inches. The greatest fall registered at Tamarack was 757 inches in 1910–11. The first snowfall report, 1916–1917, from the gauging station established November 24, 1916, at Paradise Inn on the south slope of Mount Rainier, Washington, at an elevation of 5500 feet, gave a total depth of 789.5 inches. It is not unlikely that still deeper snows will eventually be recorded at higher elevations on the slopes of Mount Rainier.

The most outstanding tragedy of the Sierra snows occurred in November, 1846. The Donner party, California bound, consisting of 83 persons, numerous cattle,

ICE FLOWERS, ST. MORITZ, SWITZERLAND

Here the sunlight has melted a portion of the ice along a crack and produced six-rayed cavities (negative crystals). The water within these cavities has re-frozen, forming beautiful "ice flowers"

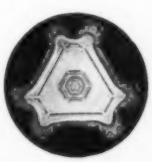
Photograph by Bessie Wiley Fisher

A NATURAL BRIDGE OF HAILSTONES, NEAR RATON, NEW MEXICO

These hailstones, which were about the size of walnuts, fell during a thunderstorm on August 2, 1927. Dr. G. Clyde Fisher, Mrs. Fisher, and Mr. Severs of the American Museum, were passing Waggon Mound Station as the hail fell. The hail formed a deposit knee deep over many acres. The warmer waters of the stream, however, melted a number of the hailstones and thus formed a natural bridge

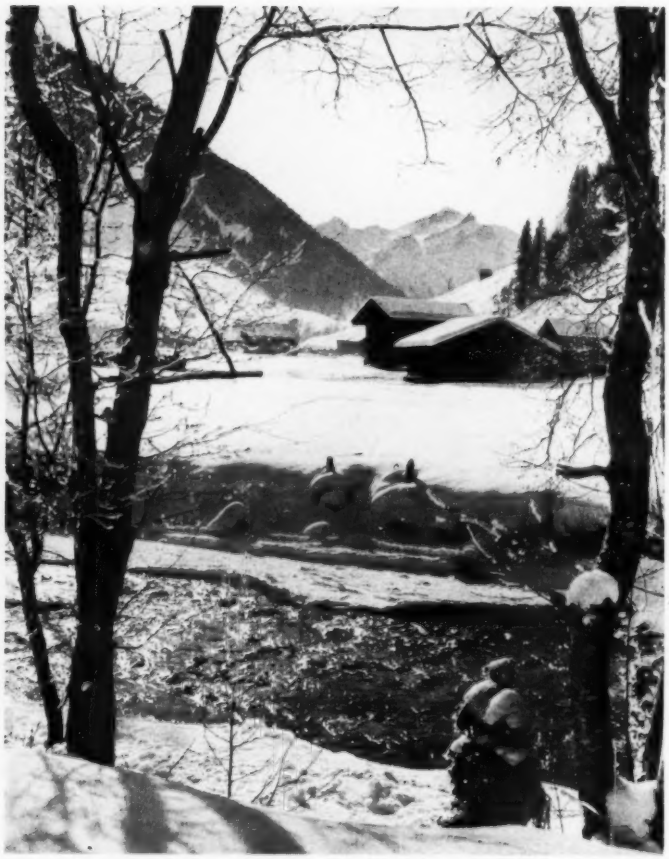
horses and "prairie schooners," was caught in a snowfall of twenty feet at Donner Lake. The cattle and horses were submerged and frozen, and of the 83 persons only nine survived the winter.

The effects of the high Sierra Nevada-Cascade mountain slope in causing a heavy precipitation locally and a decrease in the depth of snowfall to the eastward over the areas of the Great Basin, the Rocky Mountain district, and interior plateaus, is very marked. The heavy snows of the Rocky Mountains amount to more than 100 inches annually over fairly large areas as far south as northern New Mexico; restricted areas in southern Wyoming have as much as 300 inches, and those in Colorado 400 inches annually.



East of the Continental Divide the snowfall rapidly decreases with the lines of equal depth extending in an east-west direction under the control of latitude until the Great Lakes and the Appalachian Mountains are reached. In the east the rising slopes of the Appalachian, Adirondack, Green, and White mountains exert subordinate, but nevertheless, important controls in the precipitation of snow.

The Appalachian Mountains carry the lines, 50 to 100 inches, as far south as West Virginia, while the warm waters of the Gulf Stream bend the lines northward along the Atlantic Coast. In the vicinity of the Great Lakes, especially on their lee or eastward shores and thence along the Canadian boundary as far as New England, there is a relatively heavy snowfall varying from 80 to more than 100 inches. Over the north Atlantic states the northeast wind from the Atlantic Ocean, being cold and damp, is the chief source of snow. The heaviest snows fall in February or even March. The northwest winds blowing on the rear of



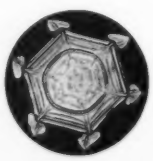
A BEAUTIFUL WINTER SCENE NEAR GSTAAD, SWITZERLAND
This view is one of the many pretty winter sights along the scenic electric railway which leads from Montreux to the Bernese Oberland

the storms are cold enough to give snow, but are generally too dry. Exceptions for the northwest winds are to be made on the western slopes of the Appalachians and places to leeward of the Great Lakes. Most of the snow falls from December to March, but at the higher elevations it begins as early as October or even September and falls as late as April or May. In general, topography is seen to be the most striking factor of control in the western states, and latitude in the eastern ones.

It is a well known fact that ice is the solid form of water produced by freezing. It is a brittle, transparent, and colorless solid, which assumes crystal forms belonging to the hexagonal system. It is characterized by a prominent habit of twinning in producing the beautiful ice flowers of hoar-frost. It is frequently precipitated from the air as frost, rime, glaze, sleet, hail, or snow.

Water in ordinary cases freezes at 32° Fahrenheit (0° Centigrade). When pure water, however, is placed in sealed tubes and kept perfectly still, it freezes spontaneously between −2° Centigrade and − 1.6° Centigrade, mean − 1.9° Centigrade. This difference of almost two degrees in the freezing state of water is due to the air being impregnated with germ crystallites of all common substances. It is to these germ crystals that most common crystallizations of substances from their solutions and from the fused state are due. Freezing is retarded by substances in solution; for instance sea water freezes at about 27° Fahrenheit (−3° Centigrade). The ice thus formed is found to have rejected four-fifths of the salt which was originally present.

Under the influence of heat, ice itself behaves as most solids do, contracting when cooled, expanding when heated. As regards the evaporation of ice, it was shown by Barnes and Vipond in 1909 that it goes directly into

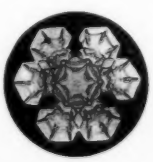


vapor without passing through a preliminary liquid phase.

Although there is no rise of temperature accompanying the melting of ice, a definite quantity of heat is absorbed, namely, about 80 calories per gram or 79.818 thermal units. The same amount of heat is evolved when water becomes ice. In other words, the amount of heat required to convert ice into water or vice versa would raise the same amount of water through 79° Centigrade. This is called the latent heat of fusion of ice or the latent heat of water. Because of this fact, ice is the most difficult of all solids to melt, as regards the amount of heat energy required to be put into it in order to effect fusion, and water the most difficult liquid to freeze, of all substances, owing to the relatively large amount of the latent heat needed. It is fourteen times as great as for lead, and twenty-eight times as great as for mercury.

HIGH WALLS OF ICE FORMED BELOW NIAGARA FALLS
King winter reigns supreme amidst this labyrinth of crystal caves and towering buttresses draped with huge stalactites, stalagmites, and columns of ice

Another remarkable property of ice is that its melting point is lowered by increase of pressure. The rate at which this occurs is 0.0075° Centigrade for every atmosphere of pressure. This fact was theoretically predicted by James Thomson in 1849, and demonstrated by Sir W. Thomson (Lord Kelvin) in 1850.



When winter comes, it is of interest to note that the fresh water of lakes and ponds continues to contract with increasing cold. The surface waters being colder and thus heavier, sink, and the warmer waters from the bottom rise to the surface. These convection currents continue until all of the water in the lakes and ponds has been reduced to the maximum density of water, after which the circulation stops, for the surface waters, when cooled to lower temperatures, remain on top and grow steadily colder until they suddenly freeze at 32° Fahrenheit.

The temperature at which water reaches its maximum density and what

DEEP SNOW IN THE ALPS MOUNTAINS
A powerful snow plow on the Berniner Electric Railway which connects St. Moritz, Switzerland, with Tirano, Italy, enables the railroad to operate through any quantity of snow

follows needs a bit of explanation. According to the researches of Joule and Playfair, water exhibits the unusual property of possessing a maximum density at a temperature of 39.2° Fahrenheit (3.945° Centigrade). When cooled below this temperature, water expands instead of contracting, and the expansion goes on to the total extent of one-ten-thousandths of its bulk, until freezing occurs, when there is a sudden expansive leap of nearly a tenth of the whole volume of the water, as it freezes. On becoming ice, the water has increased in bulk by nine per cent, and this increase occurs instantaneously and with enormous, well-nigh irresistible force.

Large-scale operations of this phenomenon may be noticed during the winter and spring months along the shores of lakes and large ponds, by the appearance of newly made ridges, consisting of sand, gravel, and large bowlders, which have been pushed up by the expanding ice. This force is also brought home to all of us by the bursting of water-pipes exposed on cold winter nights, when they are full of water with taps all closed and no possibility of escape. Cannon shells filled with water, sealed, and allowed to freeze, burst in like manner.

The expansion of water to such a degree on freezing is, of course, of great value in gardening and agriculture, in the breaking up of the soil and its disintegration into small grains. It may be noted that in the spring of the year when the frost is coming out of the ground that the soil is spongy and easily worked as compared with the late summer, when it is dry, compact, and hard. Water finds its way between the joints in the rocks, rends them apart on freezing, and is thus an important factor in the decay and denudation of rocks.

By reason of this expansion, a piece of ice weighs less than an equal bulk of water. If a certain bulk of water weighs 1000 pounds, a piece of ice of the same

bulk will weigh 916 pounds. Thus ice, being lighter than water, floats in ponds, rivers, lakes, and the open sea, when broken up, with about one-tenth of its volume above water level.

Ice, like snow, forms six-rayed crystals. They are formed when water crystallizes into ice. Due to the fact that ice and water are so optically alike, the crystals are rarely seen, but have been observed as floating free on the surface when water freezes slowly.

When sunlight or the beams from an electric arc lamp fall upon lake or pond ice, six-rayed stars called *ice-flowers* may be formed. The heat rays dissolve the solid structure of the ice crystals with such regularity as to produce cavities in the ice which have exactly the same hexagonal symmetry as snow crystals. They may be termed negative crystals.

These cavities are filled as far as possible with the water produced by the melting of the ice; but as this water is less in bulk by 9 per cent, as noted above, it cannot fill the cavity, so there is an apparent bubble left, about the center as a rule, which is vacuous. All of these delicate flowers are formed parallel to the surface of freezing.

In the northern portion of the United States and in Canada, ice forms on the lakes as well as the rivers. The St. Lawrence River, for example, is completely closed to navigation from December to April, and sometimes in May. The Hudson River freezes over every year at and above Newburgh. Even the Niagara Falls are largely arrested by freezing during February. The mist below the Falls freezes, producing remarkable ice structures, which stimulate cave formations, forming columns, stalactites, and

A 1919-1920 WINTER SCENE IN NEW YORK CITY

In January and February, 1920, the streets were more effectually blockaded by snow than at any other time in the city's history. The removal was difficult, since layers of ice had formed at different levels

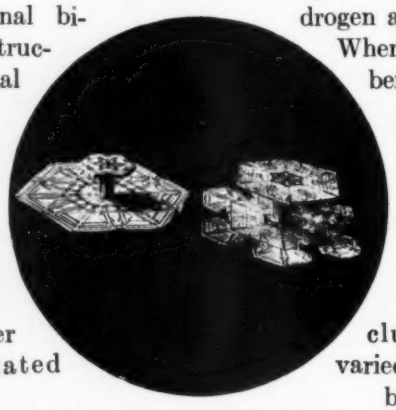
stalagmites. Ice is also formed above snow line in high mountains and the polar regions by the conversion of snow into glacier ice. It also forms on the polar seas as pack ice; in fact, ice is produced in unlimited quantities by the process of nature in all climates where the temperature drops to 32° Fahrenheit (0° Centigrade) or lower.

Ice also exists in the form of minute needles or spiculæ in the higher atmosphere. From the enormous height at which some cirrus clouds float, 30,000 feet, and the low temperature they must consequently encounter, –27° Fahrenheit, it is impossible that they can consist of water. There is no doubt that the tiny drops of which they are composed are frozen, and it is on account of the light refracted by these banks of minute ice particles that the formation of halos and similar phenomena are possible, for only when the light has passed the prisms of ice, do we discern these phenomena when we look at either the sun or the moon.

The new method of investigating crystals by x-rays, which was begun in 1912, has been applied to ice and its structure determined. Sir William Bragg (1926) shows ice to belong to the "holohedral" class 27, that of fullest hexagonal symmetry, the dihexagonal bipyramidal class. The structure is that of a hexagonal lattice made up of four interpenetrating trigonal prisms (length 4.52×10^{-8} cm. or 1/55,000,000 inch; height 7.34×10^{-8} cm. or 1/34,000,000 inch). Each atom of oxygen, diameter 1.30×10^{-8} cm., is situated at the center of gravity of four neighboring equidistant oxygen atoms, and between it and each of them lies a hydrogen atom, diameter 1.46×10^{-8} cm., an arrangement which causes twice as many hydrogen atoms to be present as there are oxygen atoms. Each unit cell of the lattice contains four molecules of water (H_2O).

The structure is a very open one. It thus reveals why ice can be melted under pressure, for there is ample room to force the arrangement into smaller bulk, a state corresponding to liquid water. The molecules of liquid water are spaced just enough to permit of their free movement over each other, while in solid ice there are relatively large openings between them. This explains how it is possible for water to occupy less space than ice, and accounts for the sudden and relatively enormous expansion which occurs when water freezes.

We have now called attention to the various forms of ice which occur on the earth and up to the height of the highest clouds. We have also briefly referred to the various circumstances under which they appear, and noted some of the characteristics of each. By application of x-rays we have been able to ascertain not only the symmetry of the crystals of snow and ice, but actually also to determine the relative positions of the atoms of hydrogen and oxygen within them. When we recall that the number of molecules in a cubic centimeter of ice is calculated by Dennison to be 31,540,000,000,000,000,000,000, we note that we are dealing with large and intricate figures. We may thus conclude that ice and its varied forms are not only beautiful to behold and to comprehend but that they are of interest to the layman as well as to the scientist.



AN ODD TYPE OF SNOWFLAKE

The crystals consist of two basal plates attached to the ends of a short vertical column or axis. One of the attached plates is more fully developed as compared with the other

Two Beduins Ask the Field Expedition for Water

EARLY MAN IN NORTH ARABIA

Geological and Archæological Evidence Indicates that This Desert Area Was Once so Fertile and Well Watered that It May Have Supported a Large Semi-nomadic Population in Prehistoric Times

By HENRY FIELD

Assistant Curator, Field Museum of Natural History, and
Leader of the Captain Marshall Field North Arabian Desert Expeditions 1927–1928

With Photographs from The Field Museum of Natural History

THE North Arabian or Syrian Desert is bounded to the west by Trans-Jordania and Palestine, to the north by Syria, and to the east by the "Fertile Crescent," lying between the River Euphrates and the River Tigris. To the south lies the great Nefud Desert, consisting of thousands of square miles of sand dunes, comparable to great expanses of the Sahara of North Africa.

The area in which these scientific expeditions worked lies between Damascus, Amman, and Ma'an, on the old railroad line which ran as far south as Medina, and the city of Baghdad to the east. During the World War most of the bridges and a great part of the railroad track was torn up south of Ma'an by Colonel T. E. Lawrence, and other British officers in that campaign. There is now, however, a regular train service as far south as Ma'an.

To the east of the railroad lies a wide bank of sand-covered flat country, with occasional low ranges of hills. There are numerous mud-flats of varying extent, indicating that at one time there was considerable water in this region. During the greater part of the year these mud-flats are waterless, and form wide patches of hard sun-cracked sand. Farther to the east rise the foothills of the great Harrat ar Rajil, covered with basalt bowlders of various sizes. This lava bed is some 150 miles in length and about 100 miles in width. The highest peak, Jebel Ashqaf, rises to 3700 feet above sea level, and is surrounded by chains of high mountains. As there is no water anywhere in this entire area, it is completely uninhabited today.

The region lying beyond the eastern extremity of the lava bed consists of a hilly wilderness with large, flat, high

A BRITISH MILITARY PARTY ON THE DESERT

Owing to the kindness of the British Air Force, the expedition was allowed to accompany one of the military patrols and to visit places which otherwise would have been totally inaccessible owing to the danger of Beduin raiders. The Beduins are generally quite friendly during the day, but at night every precaution must be taken to avoid a surprise attack at dawn

plateaus of alternating bands of flint and sand, cut at intervals by old stream beds or wadis, which sometimes contain water in the rainy season.

The general lack of water and the rugged nature of the basalt country, together with the hundreds of miles of stony desert—waterless today save for the few wells known to the Beduins, have caused this territory to be known as a geographical migratory barrier. It was also presumed that the ancient migrations did not cross this dry and barren strip of land, but rather that they passed to the north through what is now called Turkey-in-Asia, and down the seacoast into Egypt. From the recent archæological survey it can be concluded that Man in a prehistoric phase of culture crossed or perhaps lived in this great stony wilderness. From these recent discoveries it seems very plausible to suggest that in Palæolithic and Neolithic times water was much more abundant, and the stony wilderness was then able to support a considerable population. The Beduins today migrate over this large plateau with their thousands of sheep and camels, following definite routes and seasons handed down to them by their forefathers.

In December, 1925, Professor Langdon, Mr. Dudley Buxton, and I were on our way to join the Field Museum-Oxford University Joint Expedition at Kish in Mesopotamia. Owing to the political difficulties in Syria and the lawless raiders of the Jebel Druze mountains, the regular motor route from Damascus to Baghdad was impassable, and the Nairn Overland Desert Mail Convoy, with which we were traveling, proceeded via Jerusalem and Amman to Baghdad.

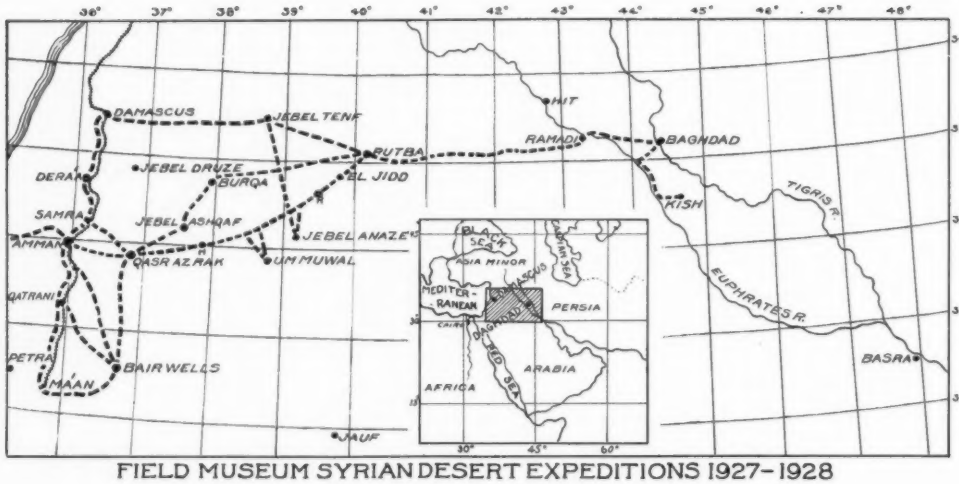
Following the Middle East Conference of March, 1921, an Air Route was laid out between Cairo and Baghdad. At intervals between Amman and Baghdad landing-grounds about fifteen miles apart were marked, and between these landing-grounds a plowed furrow was dug, so as to be visible from the air, and to guide the air pilots. At each of the landing-grounds a large letter of the alphabet was dug in the ground, to show the pilots over which landing-ground they were passing. Going east from Amman the letters continue in sequence as far as landing-ground "R," which is 237 miles east of Amman. From this point to Ramadi, Roman numerals are used, running from the numeral XI to I, which lies just west of Ramadi.

The morning following our departure from Jerusalem, the convoy reached a large mud-flat bounded on three sides by bowlder-covered hills which formed a well sheltered depression. It was here that Mr. Buxton discovered a chipped flint implement—undoubtedly chipped by man. This was indeed a very important discovery, and during the brief halt for breakfast, other specimens were collected. The time was very limited, but even this small collection proved the former existence of Man in that depression. The arrêtes were in all cases worn very smooth, and from the general characteristic features it was suggested that these were typologically palæolithic (probably Mousterian) implements. Many specimens were collected along the route whenever time allowed, and the places at which they were found were accurately recorded. Miss Gertrude Bell, honorary director of antiquities in Iraq, showed a keen interest in this collection, and gave us some valuable suggestions for further work.

Professor Langdon remained at Kish with Mr. Mackay to continue the excava-

A BRITISH ARMORED CAR

These machines, equipped with a machine gun and heavy armor plating, weigh about five tons and can travel fully loaded at seventy miles an hour over the hard mud flats



FIELD MUSEUM SYRIAN DESERT EXPEDITIONS 1927–1928

SCALE 100 MILES

tions, and Mr. Buxton and I returned to Baghdad during January, 1926, to find that, thanks to the kindness of Air Vice-Marshal Sir John Higgins, whom we had approached by letter, we were allowed to accompany an armored car patrol as far west as landing-ground "H," and to make collections whenever compatible with the official patrol duties. The patrol consisted of two armored Rolls-Royce cars, and one Rolls-Royce tender, under the charge of Flight Lieutenant R. L. Sweeney. Several prehistoric stations were found before reaching landing-ground "H," where a more prolonged and careful search added materially to our previous series, and confirmed the hypothesis of human occupation at an early date, suggested by Mr. Buxton's discoveries some little time before. A close examination of the entire collection revealed the fact that typologically our series ranged from Mousterian right down to modern "strike-a-lights," which are dropped by the Beduins today. This general classification was accepted by the Society of Antiquaries of London, before whom a paper was read by Mr. Buxton in April, 1926. The Abbé Breuil of Paris, Professor Burkitt of Cambridge, Mr. Henry Balfour, and Miss Dorothy Garrod of Oxford, accepted this classification and at once realized the significance and importance of the discovery.

Thus, when I was ordered to join the expedition at Kish for the season of 1927–1928, an opportunity for the continuation of this desert work immediately suggested itself. Following the approval of the Director, and with the coöperation of the Air Ministry in London, everything was arranged, providing that no local disturbance or rising of the tribesmen prevented the start of the expedition. Group Captain Rees, V. C., Officer Commanding Trans-Jordania and stationed at Royal Air Force Headquarters at Amman, assisted the expedition in every possible manner. Group Captain Rees, himself a keen archæologist, was able to make many valuable suggestions as to the probable localities where prehistoric man might have lived.

Leaving Amman in the Field Museum Cadillac and accompanied by Flying Officer Silcox as escort, the expedition proceeded south to Katrani, following the desert track along the railroad line. Leaving the railroad at this point, we struck off in a southeasterly direction for the famous Wells of Bair. We passed over many flint-covered hills, and at the end

of a long and tiring day reached our objective. In the gravel just below the Arab ruins, water-worn and rolled implements of Upper Chellean type were found at a depth of 11 feet 6 inches from the top of the gravel bed. These implements were found in place after some digging had been done in the face of the cliff. This was the first time that implements of lower palæolithic type were discovered *in situ* east of the Hejaz Railroad.

Charles M. Doughty, in his *Travels in Arabia Deserta*, quotes the following instance of his discovery of chipped implements, more than fifty years ago:

> Walking in the torrent bed at Ma'an my eyes lighted upon,—and I took up, moved and astonished, one after another, seven flints chipped to an edge; we must suppose them of rational, that is an human labour. But what was that old human kindred which inhabited the land so long before the Semitic race?

In another place Doughty says,

> I have found in it (the gravel bed near Mt. Seir or Jebel Sherra) such wrought flint instruments as we have from some river and lake gravels and loams of Europe.

These specimens are now in the University Museum at Oxford.

On account of the danger from raiding parties, we had to leave the Wells of Bair before nightfall. We were reluctant to leave this fascinating place, far from all habitations, amid perfect lifeless silence.

As we turned to the west toward the railroad, we passed the Wells of El Jefer, where young Mohammed Abu Tayi was encamped. He greeted us very cordially, and showed us three ostriches, which he very courteously offered to us. We were interested to see ostriches, because they had been reported between Amman and Baghdad in 1921, when the Air Force Route was being marked out. Mohammed is the son of the late Auda Tayi,

QASR BURQA, THE MOST EASTERN OUTPOST OF THE ROMAN EMPIRE
This fortress is built of large basalt bowlders all faced and laid in position without the use of mortar. The Roman legions to whom this task was given must have spent many months in thus protecting themselves from the raids of the Beduins

THE APPROACH OF A SAND STORM

Sand storms often come with very great rapidity and violence. They are often very dense and suffocating, and when a party is out on patrol, it is necessary for each car to keep in touch with all of the other cars in the convoy to avoid being separated from them

whom Colonel Lawrence called "the greatest fighting man in Northern Arabia." Miss Gertrude Bell once said, "I fancy that when you have drunk the milk of the vaga over the camp fire of Abu Tayi you are baptized of the desert, and there is no other salvation for you."

We took numerous photographs and moving pictures of the tribal tents and of the wild Beduins.

We continued westward to the railroad, stopping for one day to visit the rock-hewn fortress of Petra, "the rose-red city, half as old as time," and continued following the railroad back to Amman. We were pleased to have discovered a number of open-air prehistoric sites, and particularly to have found implements of Upper Chellean type actually in place in the gravels of Wadi Bair.

A few days later we were allowed to accompany a convoy of five cars that were on their way as far east as landing-ground "R," to re-mark the landing-grounds which become obliterated owing to sand storms. We followed the Air Force Route to Qasr Azrak, an old Roman fortress which is now partially inhabited by Druze, who wish to be under British protection. A few miles to the east we entered the Harrat ar Rajil, and as we passed slowly along the very rough track, often not making more than eight miles in one hour, we observed basalt bowlders arranged in the form of circular walled enclosures. These stone circles are of various dimensions, the largest being thirty feet in diameter. In most cases the walls are broken down and have obviously not been in use for a considerable period. Sometimes the stone circles are solitary, apparently always above the possible water-level of the valley in which they are situated, and usually on the slopes of low

hills. The Beduins told us that these stone circles were used as sheep-folds at night, and that in certain localities they are used for that purpose today. However, whether upon the hills bordering a mud-flat, or upon either bank of a dry stream bed or water course, we found numbers of stone circles which appeared to us as village settlements. In other localities the buildings appear to have been square or rectangular, and many of these walls are standing four or five feet in height, which would indicate that they are not of any great antiquity.

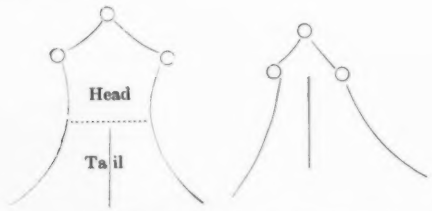
Flint implements, mainly of Neolithic type, were found in profusion in the immediate neighborhood of practically all of these stone buildings, although there might not be flint in the immediate vicinity. Collections of flint implements have been made from many of these sites, and it remains to study them in detail before any definite conclusions can be drawn. Buildings of stone, both round and square, occur in hundreds dotted over the area covered by the archæological survey, but there are literally thousands of them in the great lava bed. Photographs from the air taken by the Royal Air Force at a height of about 9000 feet show numbers of these stone circles, also long walls built up of these same basalt bowlders, apparently quite unconnected, and whose purpose still remains a mystery.

Strange ruins which, from their form have been called "kites" by Group Captain Rees, are very numerous between Azrak and landing-ground "H." These "kites" are composed of walls with a round tower at intervals, and with long walls called "tails" which extend for miles across the country. There are many different kinds of "kites," but one of the

THE ROMAN FORTRESS OF QASR AZRAK

This stronghold is about eighty miles to the southwest of Qasr Burqa across an almost impassable section of a great larva bed. This fortress is now occupied by Druze forces under British protection

simplest forms is shown in the following diagram.



Since these "tails" are sometimes eighteen miles in length, it does not seem plausible to suggest that they could have been fortresses of any kind, but rather traps for catching gazelle or some other animals. Group Captain Rees suggests that some of these "kites" whose "tail" opens upon a mud-flat some hundred yards away from the "head" were used as fortresses. To explain the dividing wall which sometimes runs down the center of the "tail" of the "kite" he suggests that domesticated animals were kept on one side of the wall, and that rudimentary forms of agriculture were practiced on the other. Presuming that the mud-flat was at that time a small lake, it would have been possible to guard the wide area at the extreme end of the "tail" with one or two men, who could not fail to hear the approach of the enemy over water. At the first signal of alarm the animals would be driven into the "head" of the "kite," and the last wall hurriedly built up. In this position they would be safe from attack from any side. It is interesting to note that the walls connecting the towers are built on a curve with the highest part of the wall nearest to each of the towers. This would tend to make the attackers rush for

SHEIKH MOHAMMED ABOU TAYI IS HOST TO THE VISITING SCIENTISTS

Mattresses are placed on the ground around the hearth, and for distinguished visitors the Sheikh himself always makes coffee, which is a very elaborate ceremony. The head men of the tribe sit in a circle around the fire, and in the evenings most of the conversation deals with religious subjects. The wonderful array of coffee pots can be seen in the photograph, all of them having been handed down for generations. The Sheikh's body guard is gathered behind him. This group is almost invariably within call

A BEDUIN BLACK TENT

The nomadic Beduins live in these black tents, which are made of camel's hair by the women of the tribe. The number of tent poles used to support the long strips of cloth indicates the wealth and power of the owner of the tent. For example, the tent of the Sheikh has the greatest number of tent poles, and is thus easily recognized from afar. In hot weather the sides of the tent are propped open in order to permit every possible breath of air to enter

the lowest part or center of the wall, and in their efforts to break through they could be attacked from the sides, as well as from the front. This is one of the principles of close fighting today. The machine guns are placed on the flanks, and every effort is made to make the enemy "bunch" at one place.

Flint implements are always found in these "kites," and these will have to be studied in detail. It is often very hard to follow or even to find these stone walls upon the ground, but air photographs help to overcome this difficulty. There are many types of "kites," ranging from the simple form described above to the most complex, which is only discernible from the air.

In various localities we found inscriptions upon the bowlders of basalt which are presumed to be of Nabataean or Safaitic origin. Since the Nabataeans, according to Pliny, lived in the city of Petra about eighteen hundred years ago, this would mean that the inscriptions copied by us are not more than two thousand years old. In certain rare instances camels, horses, and men were carved upon the rock and these were all duly copied and recorded. Arabic inscriptions are rare, and usually take the form of "Bismillah irraham irrahim," meaning "In the name of Allah, the Merciful, the Compassionate." A door lintel at Burqa has a clear Arabic inscription which we copied. The Beduins leave their tribal marks or cattle brands upon the walls of buildings or upon graves, to indicate, in the latter case, the tribe to which the deceased belonged. These markings are called waṣms; they were all copied and the locality in which they were found was noted. As each tribe passes by a certain well-known landmark the waṣms are hammered on the surface of one of the blocks of stone in the neighborhood. From a collection of these waṣms taken at a given point, it is possible to say

A ROMAN ARCH AT QASR BURQA
This arch, after nearly two thousand years, is still standing exactly as it was erected by its builders

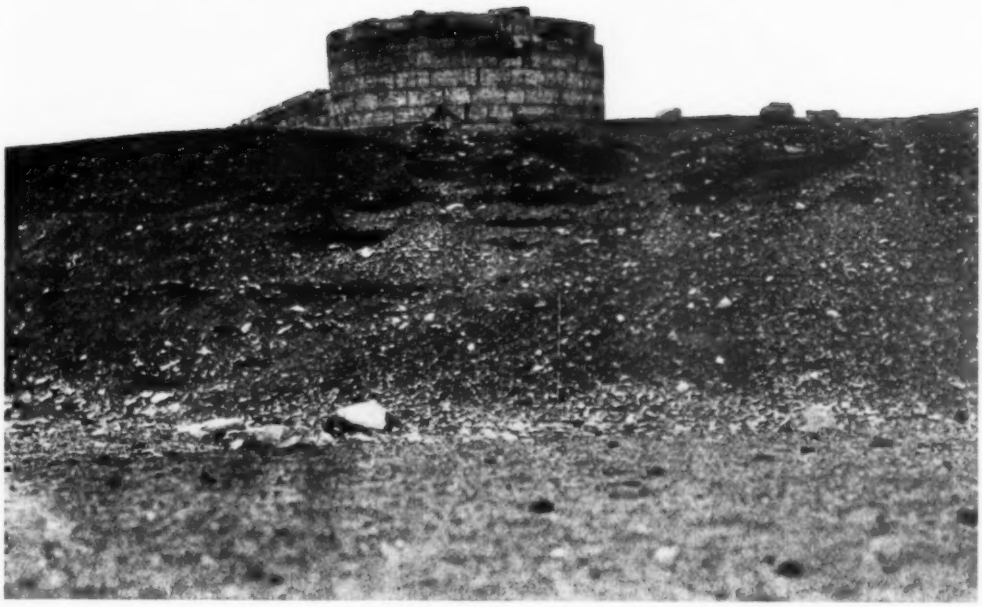
which tribes or sub-tribes have passed by in recent years.

Leaving the lava bed, we proceeded slowly along the Air Route, collecting flint implements and recording carefully the positions from which they came. Detours were made to search on the tops of any hills that seemed possible points of vantage for prehistoric peoples. On the top of Umm Muwal, twenty-two miles south of landing-ground "M," at a point 3200 feet above sea-level, we found the most important collection of typologically Mousterian implements, including a very perfect, heavily patinated, small *coup-de-poing*. So far as we know, we were the first Europeans to visit Umm Muwal, as this is actually in the territory of Ibn Saoud, king of the Hejaz, although we did not realize this at the time.

We left the convoy at landing-ground "R," and continued into Baghdad, with our heavy weight of stone, which proved the former existence of prehistoric man in many different localities between the Hejaz railway and Rutba Wells.

* * *

The results of this first expedition seemed sufficiently important to warrant an additional survey to the north of the course that had been covered during 1927. With a further appropriation from the Captain Marshall Field Fund, it was decided to make a more detailed survey in a new area upon a larger scale. With the permission and coöperation of the High Commissioner and the Air Vice-Marshal in Iraq, the expedition, consisting of myself, Mr. Eric Schroeder, who was to study any historical ruins and inscriptions, Mr. Showket of Baghdad as moving picture operator and photographer, and a Russian named Vania as mechanic, was invited by Major A. L. Holt, to accompany the Turkish Petroleum Company's Pipe Line Survey from Samarra to the Mediterranean. During April and May of this year thousands of miles were



IN THE DRY BED OF THE WADI BAIR

At a depth of eleven and a half feet below the surface a large number of Upper Chellean flint implements were collected. They were badly water worn and undoubtedly had been carried down from some point higher up the stream

A DOOR LINTEL OF THE EIGHTH CENTURY

This inscription is dated "81 A. H."—that is, 81 Anno Hegiræ, or 81 years after the flight of Mohammed, which places it at 703 A. D., the Hegira having taken place in 622 A. D.

covered between Rutba Wells and Amman. As the survey party proceeded relatively slowly in making their observations and maps, we were able to make fairly detailed archæological surveys along the traverses which they covered. The positions of sites where we collected implements of palæolithic and neolithic types were accurately recorded, and can be plotted on the survey party's map.

Among other important places visited was the Roman fortress of Qasr Burqa, which lies about 38° east and 32°5′ north, far out into the desert, about seventy-five miles from water. We were the next scientific party to visit this spot after a visit of Miss Gertrude Bell in 1913. We copied the inscriptions and planned the buildings, while Mr. Showket took numerous photographs and moving pictures. A large door lintel was found upon a Beduin grave. Although this weighed more than two hundred pounds, it was removed in order to study the Roman-Greek inscription, in the hope of finding a reference to the date of the Roman occupation.

The convoy consisted of six automobiles with twenty-eight persons in all, headed by Mr. W. E. Brown who, with Mr. H. F. Moon, was making the survey. We were escorted by ten native police. As the temperature often exceeded 106° in the shade, our water supply had to be very carefully conserved.

When the survey was completed between Rutba and the lava bed, camp was moved to Qasr Azrak toward the end of May. Work was continued in this area for the next few weeks, after which we accompanied a patrol to Bair Wells. This afforded an opportunity for making further observations at several points.

Wishing to continue the survey to the north, we went on to Damascus and accompanied a Nairn Mail Convoy back via Rutba Wells to Baghdad. The specimens were packed and shipped to Chicago for study.

It is now possible to state with absolute certainty that Man in a prehistoric phase of culture inhabited this North Arabian or Syrian Desert over a long period of time.

Geological evidence supports the view that this area was once so fertile and well watered that in prehistoric times it may have maintained a large semi-nomadic population.

Many of the Mousterian types of implements found during the desert archæological survey work resemble very closely the implements found in association with the "Galilee" skull in Palestine during August, 1925. These results prove the eastward extension of our knowledge of the area once inhabited by palæolithic man and it remains for future scientific expeditions to link the recent discoveries in Mongolia and the Ordos region of China with the Near East, North Africa, and Western Europe. I feel confident that the North Arabian Desert lies upon one of the main lines of migration between the East and West, and that prehistoric sites will be found from North Eastern Iraq to China.

MOSQUITOES AND OTHER FLIES

Despised but not Always Injurious—Sometimes of Remarkable Form and Beauty—Often with Most Surprising Habits

By C. H. CURRAN
Assistant Curator of Insect Life, American Museum
Illustrated by R. R. Schultz

WHEN we speak of flies, most of us at once visualize the common house-fly, the bluebottle, or one of the near relatives of unsavory habits. In short, the average conception of a fly is that of an insect which is disgusting in its habits and also injurious to man. Such ideas are not unnatural, since it is because of their close association with us that flies have come to be considered something of importance in the civilized world and something of a menace to civilization itself. If it is true that malaria was responsible for the downfall of Greece at the height of her glory, resulting in a decided setback to the advance of civilization, there is ample reason for condemnation of flies, since it is a well-known fact that the mosquito, which is a fly, is essential to the development and spread of this disease.

The sportsman who spends any time in the woods, and the greater number of city dwellers (now that frequent visits to the country are possible as a result of improvement in transportation) come into contact with flies of a very different kind from those encountered about the home. The mosquito is probably the most commonly encountered fly in the nature of a pest that one meets in the woods, but it is not limited to such habitats. There are many kinds of mosquitoes and they have various habits. Some of them are carriers of malaria, while others are irritating merely because they are persistent "biters." Perhaps one of the most surprising things in connection with mosquitoes is that the aquatic young, "wrigglers," of certain species occurring in the tropics live entirely upon the young of other mosquitoes. This is an example of how nature has developed a certain check upon the race of mosquitoes as a whole by means of a near-cannibalism among their own kind, and it is not inconceivable that cannibalism sometimes actually occurs.

Another common blood-sucking pest which is very well known is the black fly. Many species go under this name and they vary in size and habits. Most of them bite humans, and the results of their bites are frequently most serious. Unlike the mosquito, they give no warning of their attack, either by buzzing before commencing their meal or by the injection of an irritating fluid. They feed until their small bodies are fully distended with blood, and then go peacefully on their way.

A short time after, the region in the vicinity of the puncture becomes inflamed and itches in a most tantalizing manner. It frequently happens that several flies have completed their meal and departed before they attack in numbers, and the irritation caused by their bites attracts attention to the newcomers, who are called upon to pay the penalty for the crime of their predecessors. Like mosquitoes, black flies live during their early stages in water, but unlike the former, they usually breed in fast-flowing streams, and are therefore encountered by trout fishermen more than by others. In addition to attacking man they attack various animals and some species have been known to kill young geese; others attack fish.

There are in all parts of the country

A FLY THAT KILLS SPIDERS

This fly and its near relatives reverse the usual order of things by depositing their eggs on spiders. The maggots develop inside the spiders, eventually destroying them

tiny flies which may cause a great deal of annoyance to warm-blooded animals, including man. They are known by various names, the most common being "no-see-ums" and "punkies." They are, all unconsciously, of course, something in the nature of insect jokers. Being true flies, they have only two wings but they are very small and of a grayish or smoky brown color, and, as the name used by Indians and travelers in the northern woods implies, they are not readily seen. If they lack something in size, they fully make up for the deficiency in numbers and the intensity of their bite. In actual bulk they do not nearly equal the size of an ordinary pin-head, in fact from fifteen to twenty of them together would be required to make up that bulk. One sees nothing when they bite, but the persistent itching is evidence of their presence; something must be blamed for it and frequently the victim selects some innocent insect as the cause of the trouble, with the result that henceforth that unfortunate animal and all its kind are condemned for the crime of another. But the "no-see-um" may not live to enjoy the joke, because the brushing of a hand over the itching parts is certain to destroy a large percentage of the biting midges.

The lover of the great outdoors is not permitted to rest from the attacks of flies after exhausting the three groups already mentioned. There are many others to annoy him. The "no-see-ums" are most

common at night, the black flies during the day, while the mosquitoes seem never to rest. They are joined during the day by horse-flies and deer-flies, and these inflict a very painful bite. Probably the majority of those suffering from bites by these flies believe that they have been stung by bees. To the naturalist they do not resemble bees, but everyone cannot be expected to know the difference between them. No one need feel badly about his inability to distinguish the members of these two orders of insects, because those who specialize in their study are much more frequently deceived by the live insects than they would care to admit, and probably the deception is much more successful than these same specialists imagine. One may learn in time to distinguish them by the buzzing sound they make, but that is something apart from this story.

We will mention only one more group of biting flies which occur in America and which annoy the sportsmen in northern woods—the biting snipe-flies. I have never been subjected to their bites, but am assured that they are sometimes a major pest. It might be well to add to the list the stable-fly and the horse-fly, two near relatives of the house-fly, both of which are bad biters and exceedingly elusive. To kill them while they are engaged in their meal requires the

BIRD "TICKS"

The bird flies are parasitic upon birds. The group of flies to which these belong is known as Pupipara, because the larvæ live inside of their mother until they are ready to pupate or have already done so, when they are fastened by the mother to its host

development of a great amount of skill and consummate patience. One's temper is liable to suffer greatly if these pests are present and they may be much more annoying than mosquitoes or deer-flies. If we lived in Africa we might consider the tsetse flies, also related to the house-fly, which cause sleeping sickness. The tsetse is, however, a pest of quadrupeds, and man is not greatly bothered by it.

Mention has been made of several kinds of flies which attack man directly. Many others injure man indirectly by destroying his crops or at least reducing their yield, and by attacking animals. The house-fly and its relation to the spread of disease is too well known to need more than passing mention. Some of its near relatives are among the most serious pests of garden crops, and we find among these the radish maggot, which makes radishes unfit for consumption, not alone because of the presence of the maggot, but because the root becomes hard and fibrous; the onion maggot which destroys young onions, the cabbage maggot, which delights in the destruction of newly transplanted cabbage plants; the seed-corn maggot which lives upon sprouting seeds of numerous kinds of plants, and a long list of other species.

Looking farther afield, we find many other injurious flies. There are flies which make galls upon almost all kinds of plants and there is the Hessian fly which was at one time the despair of the wheat grower. It is still a pest, but the damage it causes is either much reduced or it has been relegated to the background by the publicity being given other immigrants to America.

A peculiar habit of some flies is that of living upon birds, and those which have this habit are well adapted to the mode of life which nature has chosen for them. They are leathery in texture, very flat, and usually of a brownish color. They are found under the feathers of birds, most frequently on the neck. Birds are attacked by other forms which, however, are parasitic upon the young and are often responsible for the death of a whole brood.

From what has been set forth in the preceding lines one might conclude that flies are terrible insects and that they are utterly useless. Such a conclusion would hardly be fair to flies as a whole. It happens that this group of insects is one of the two really important groups connected with the control of the major insect pests. A very large number of flies are insect parasites. It is true that some of them are parasitic upon beneficial insects, but the number is relatively small. For the most part, parasitic flies prey upon caterpillars, beetles and beetle larvæ. Their methods of attack are varied, and often most ingenious. In some cases the flies deposit thousands of small black eggs upon the leaves of low plants and grasses. There seems to be no system of the deposition of the eggs and it seems a very haphazard way of doing things. But eventually a caterpillar comes along and eats the leaf, swallowing the egg along with it; and in due time the egg hatches and the young maggot proceeds to feed upon the cutworm which swallowed it. Some other species have quite as interesting habits: they deposit living maggots on leaves. These are peculiar black things and they fasten themselves to the surface of the leaf and remain there for a varying length of time—in fact until some unfortunate caterpillar comes along. As soon as a hair of the caterpillar touches it, the tiny black mass comes to life, crawls up the hair, and pierces the body wall of the caterpillar, eventually killing it.

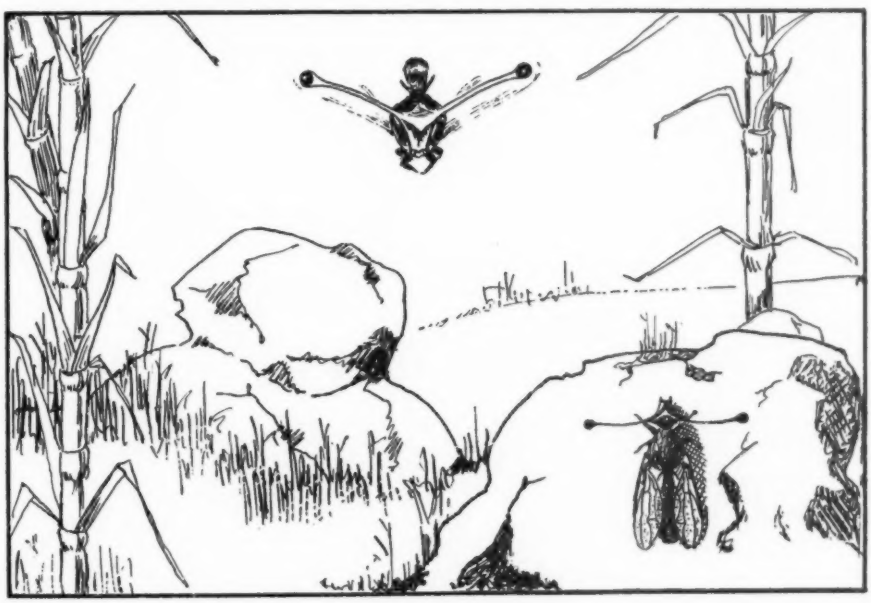
Some flies lay eggs or perhaps deposit maggots on bees while they are in flight—at any rate they are parasitic upon bees. There is one group of flies which does not believe in working for its food. These

insects allow solitary wasps to go forth to battle and bring home caterpillars, spiders, or flies which they have overcome and paralyzed by stinging. The flies are evidently cautious whilethe wasp is about, but they are also very patient, for they will watch the wasp prepare the home for its young and will wait about until food is brought, then, darting in quickly, they will drop living maggots upon the food. Since the wasps lay eggs which will not hatch for some time, the fly larvæ have a distinct advantage and are well on the road to maturity before the young wasp maggot has gotten fairly started.

There is a general impression that spiders are the sworn enemies of flies and that a fly invites death by approaching a spider. In the main this is true, but here we have another case of "the worm turning," because there are flies which are parasitic upon spiders. These are peculiar creatures, with a small, round head, often a long proboscis or beak, and a large, roundish abdomen. Often they are very beautifully colored, being metallic green, blue or black, although our eastern species are dull colored. The flies lay their eggs upon the spiders and the maggots develop within the host, ultimately destroying it.

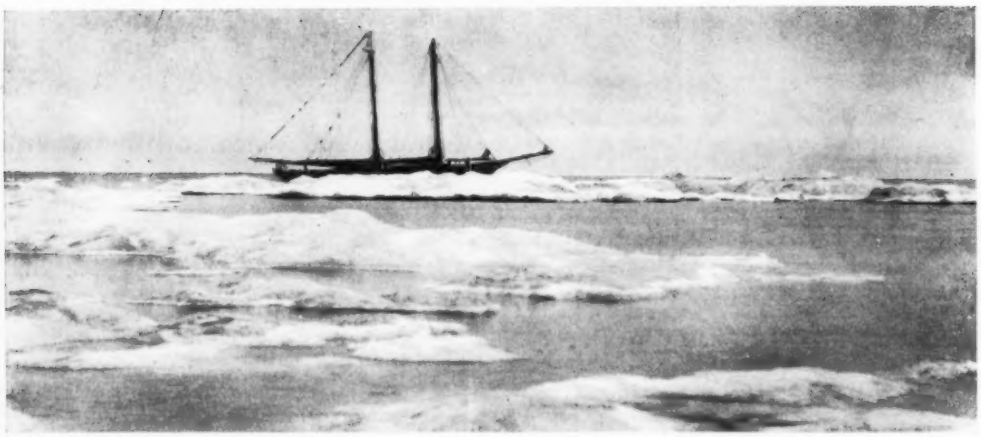
Remarkably shaped flies are not uncommon in the tropics. In the Old World there are many species of stalk-eyed flies: in America we have but one species of which the eyes are scarcely "stalked," although there are in Central America some distantly related forms which have the same character of head development. The true stalk-eyed flies are predaceous in the adult stage, and are frequently very abundant on stones in streams and upon grass stalks in swampy land.

There are many more beneficial flies and a host which are of no great economic importance, although the fact that they pollinate flowers is not to be overlooked. Also there are many injurious ones, but on the whole the preponderance is probably on the side of the beneficial.



STALK-EYED FLIES

These strange creatures which prey upon small insects are not uncommon in the Old-World tropics. The "head on" view of the fly in the air shows plainly the antenna-like "eye stalks," with the eyes placed at the ends. The other fly shown in the drawing illustrates the fact that, aside frem their eye stalks, these flies are not greatly dissimilar to their more common cousins



The Schooner "Morrissey" in the Arctic Ice Pack

TO THE ARCTIC FOR WALRUS

Collecting a Group of Pacific Walrus for the American Museum of Natural History

By H. E. ANTHONY
Curator, Mammals of the World, American Museum

The Stoll-McCracken Arctic Expedition was organized with the intention of expanding a sportsman's trip to Alaska and the Arctic Ocean into a Museum expedition, with the collecting of group material and study specimens as the features of major importance. Mr. Charles H. Stoll, of New York City, financed the expedition, and Mr. Harold McCracken was the organizer of the undertaking. Mrs. Merle L. Stoll accompanied her husband and took an active part in the work accomplished. The schooner "Effie M. Morrissey" was chartered for the trip and, under Captain Robert A. Bartlett, sailed from Newfoundland by way of the Panama Canal to Prince Rupert, British Columbia.

Here the party from the American Museum, who in company with Mr. McCracken had crossed the continent on the Canadian National Railways, came aboard, and on May 1, 1928, the expedition started northward. The scientific staff was in charge of H. E. Anthony, curator of mammals, and included Edward M. Weyer, archæologist, F. L. Jaques, artist, and Andrew Johnstone, preparator. Mr. and Mrs. Stoll joined the expedition at Port Moller, on the Alaskan Peninsula.

The most important achievement of the season in the Arctic was the collection of the group of walrus, but the party had interesting experiences throughout the entire itinerary, such as hunting the big brown bear of the Alaska Peninsula, collecting seals and cetaceans, searching for the so-called "mummies" on Unalaska, and visiting Bogoslof Island and St., George of the Pribilofs.—THE EDITORS.

WHEN the vicissitudes of navigation in Bering Sea had landed our schooner in Grantley Harbor with a broken propeller shaft (landed is used advisedly, for we were aground for fifteen days there), the expedition was threatened with an early ending.

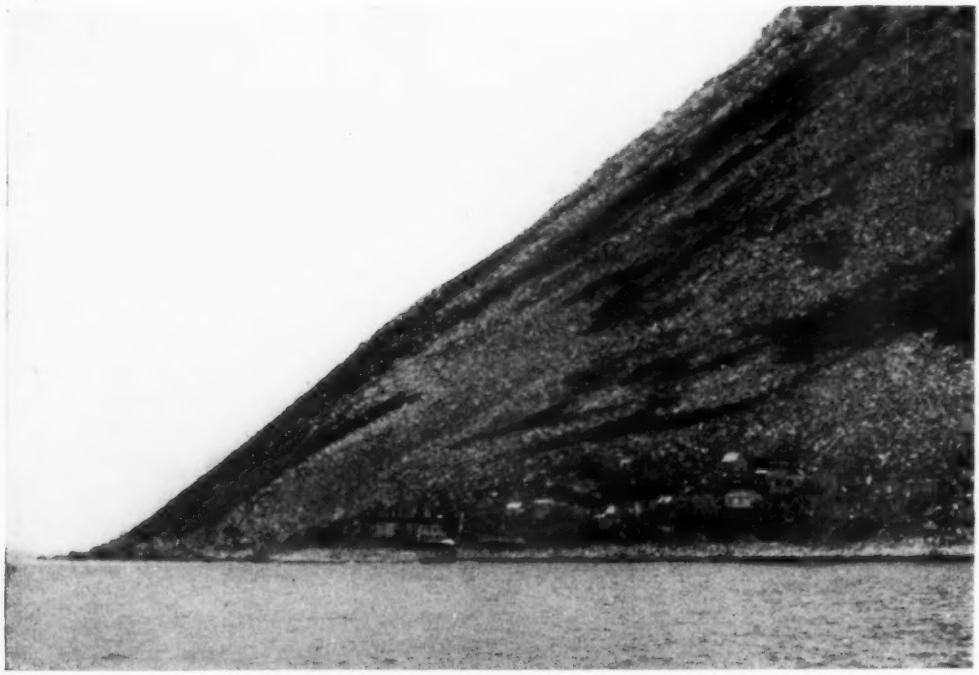
Our luck turned finally, and with a new shaft from Nome we were ready to start north once more. The morning of July 27 found us passing Cape Prince of Wales, and well out in Bering Strait we crossed from the green waters of the North American shores into a blue stream that marked the Arctic branch of the Japan current. The line of demarcation was surprisingly sharp and exact and stretched as far as the eye could see to north and south. To borrow a pedestrian's term, we crossed this line in a single step. By afternoon we reached the Diomede Islands, where we planned to take on Eskimo hunters from

Little Diomede, and also to collect birds and make studies for a group of Arctic bird life for the Museum.

The Diomedes rise sheer from the sea and stand as sentinels at the gateway to the Arctic Ocean. To the southward Fairway Rock does similar sentinel duty for Bering Sea, and on clear days one sees the two continents reaching toward one another, North America jutting out at Cape Prince of Wales, Asia at East Cape. While all this is interesting terrain and stirs the imagination, only when the sun shines (a not too frequent occurrence) can one find even a remote justification for the use of the words "friendly Arctic." At all other times these shores are bleak and inhospitable, unless indeed one has, like the Eskimo, never known the attractions of a less rigorous clime. But the sea birds find such a spot vastly to their liking and they throng to these islands in innumerable hosts. Auklets, puffins, murres, kittiwakes, and cormorants come and go in countless numbers, and in the early morning or evening the noise of their wings creates an all-pervading rush like the hiss of escaping steam from some titanic factory. Overhead, at such a time, the eye senses myriads of flying forms in numbers that defy estimate.

When at last we saw the Diomedes falling astern, we prepared for the real undertaking for which a specially chartered boat was necessary, the search into the Arctic Ocean for walrus and polar bear. We knew from the reports of traders that we should not reach the ice fields until we had sailed several days to the northward, but nevertheless we began to spend long hours on the deck, eyes strained ahead for whatever living forms this northern sea might hold. Great flocks of fulmars and shearwaters were

SEA GULLS VISIT THE "MORRISSEY"
The sea gulls were remarkably tame and lit about the schooner to pick up food which was scattered to attract them



ESKIMO VILLAGE AT LITTLE DIOMEDE

Two small islands make up the Diomede group. The eastern, or smaller island, is a possession of the United States, the other belongs to Russia. The village is perched precariously among the rocks at the very edge of the surf, for there is no level beach on these islands

flying low over the waves where the northward flowing current carried the teeming marine life that is their food. These birds are known to the whalers as whale birds, and where one sees them one may also expect to find the cetaceans. We discovered this to be the case.

Well toward the close of a beautiful, clear day we encountered finback and humpback whales in large numbers. These monstrous mammals were all about the schooner and afforded us a never-to-be-forgotten exhibit of marine life. The air was calm and quiet, the sea smooth and unruffled, and as the whales came up to breathe, the sounds of respiration could be heard for an incredible distance. This was especially true of the finback whales, which make on inspiration a very loud noise like an exhaust of live steam, audible at a distance of at least a mile under favorable circumstances. Singly and in small groups up to six or eight, the whales were rolling up to the surface or loafing about in a small area. One even appeared to be asleep on the surface and I thought the vessel would run it down, since it was directly in our course, but it sensed the vibration of our propeller just before we reached it. One of my most vivid memories of the Arctic Ocean will be the cetaceans that we saw both on entering and on leaving this body of water. On one occasion we must have seen at least one hundred of these big fellows; their columnar spouts were rising in every quarter of the compass. Some were surcharged with energy and threw themselves clear out of the water, so that the blue sky could be seen between the animal and the ocean. It was a frequent occurrence to see the great flukes rising high above the water in a graceful flourish which the mass of the creature belied as

the whale dove for some deep feeding ground. Besides the larger whales, we also met the smaller beaked whales and the large porpoise or killer whale, a predatory creature with a towering dorsal fin that cut the water with the sinister suggestiveness of a shark's fin. But the killer whale is far more deadly than any shark and takes toll of any and all of the ocean life.

Our first sight of the ice came on August 2, late in the afternoon. Seemingly far off against the horizon, there appeared a mass that looked like a distant island, and one of the Eskimos, who should have known better, identified the object as Herald Island. According to the reckoning, we were too far south to see this island, and conjecture was rife until, in a surprisingly short time, the schooner had shortened the distance and we could make out a good-sized iceberg. The Arctic atmosphere plays queer tricks at times, and mirages and other deceptive conditions of the air tempt an observer to draw strange conclusions.

When we came on deck two mornings later, not only did the ice extend as far as we could see ahead of us, but there was the added thrill of Herald Island against the horizon. This island is but seldom visited and only on rare occasions can parties penetrate the drifting ice fields and make a landing there. Not only would it have been an achievement to set foot ashore, but there was a good chance that we might see walrus or polar bear in the vicinity, so the Captain tried to work the "Morrissey" in for a landing. Twisting and turning to follow the narrow lanes that ran back through the loose ice, we finally arrived within four or five miles of the rocky beach, but were forced to give up the

ESKIMOS PUT OFF FOR THE SCHOONER IN AN UMIAK

The umiak is a large, light canoe made of walrus-skin stretched over a framework of wood. It can be hauled up on the rocks without danger of puncturing the sides, for walrus hide is very tough and strong

LITTLE MUD BAY AT LOW TIDE

One of the difficulties in navigating about Moller Bay, where the party hunted the Alaska brown bear, is the presence of extensive mud flats at low tide. Only at high water is it possible for even shallow draft craft to reach the firm shore line

attempt when the pack presented a closed front. As a change of wind might shift the ice and force the schooner into a dangerous situation in the vicinity of Herald Island, Captain Bartlett navigated the vessel back to the fringe of the pack and we began to cruise to the northeastward.

Now began a series of days of nearly identical routine. The period of daylight was long, and in addition to some one in the barrel at the masthead (usually the Captain) one or more of us kept a constant look-out from the deck for walrus or bear, from early in the morning until dark. We were in the ice or at the outer edge of it continuously, and although walrus were sighted from time to time, they were all in the water, going somewhere, and we were not able to follow them until they pulled out on the ice. The only certain way of hunting walrus is to shoot them when they are up on an ice pan. If shot while in the water the animal sinks, in the great majority of instances. Occasionally a swimming walrus may be harpooned, and a float attached to the iron marks the progress of the quarry, which may be shot and retrieved in due course of time. We could scarcely hope to harpoon a walrus from the schooner, and our best chance was to search until we discovered some that might be stalked on the ice.

After days of scouting we at last located a good-sized herd of walrus. A single animal was observed some distance ahead swimming rapidly on a course to take it across our bows. The Captain sang out from the barrel to the helmsman and the schooner swung to starboard to follow the walrus. These animals when traveling toward some fixed destination progress by surging leaps through the water, swimming alternately on the surface and below it. When an ice pan

SNOW-COVERED PEAKS AT THE HEAD OF MOLLER BAY
The first camp in the bear country was at Little Mud Bay, an arm of Moller Bay. The snow had not yet melted from the mountains, and the tracks made by bears crossing the slopes and ridges could be readily seen

lies across their path they dive and go under it. On the occasion in question we were able to keep the walrus in sight for many minutes. Each time it disappeared we looked for its reappearance along the course it was obviously following, and eventually when it came to the surface some one discovered it. Among broken ice it is an easy matter to lose even as large an animal as a walrus if it be distant eight hundred to a thousand yards.

Finally the walrus ceased its direct progress and began to swim in small circles. It bellowed and seemed to be looking for something. We began to look for something, too, for we realized that the animal was trying to locate a herd which must be near by.

A mass of discolored ice a half mile away had attracted some attention, but had been dismissed as of no importance. I turned my field glasses upon it for a better look and was amazed to see that the dark ice resolved itself into a great mass of walrus lying piled across one another. Now and then one moved or raised its head and bellowed. We had all heard the bellowing for the past two or three minutes, and now that our attention was properly focussed, we marveled that we had gotten so close without seeing the animals sooner.

At once the course of the vessel was changed and we withdrew a short distance to avoid frightening the walrus. As we slowly departed we noted the vicinity carefully, for an ever-threatening fog was lurking not far away and it was very easy to lose sight of the herd. Also we discovered a second lot of walrus on a smaller pan about an eighth of a mile from the first herd.

In a short space of time a plan of attack was outlined and the two launches were put over the side. In the large one Mr. and Mrs. Stoll, with McCracken and his

THE EDGE OF THE ICE PACK

The drift ice in the Arctic Ocean forms a more or less continuous edge. Scattered floes may be encountered at some distance from the pack, but the main body travels as a mass of loosely knit bergs and pans

ESKIMO GIRL FROM BIG DIOMEDE

The Eskimos from Big Diomede came off to visit the schooner and impressed the expedition members as a fine lot of healthy and intelligent natives

THE LAND OF THE MIDNIGHT SUN

During the height of summer the daylight never completely fades north of the Arctic Circle. At the hour of sunset in southern latitudes the northern sun is yet high in the heavens

THE SCHOONER TIES UP FOR WATER

Water for use on the "Morrissey" was dipped up from pools formed in the ice. On large floes pools of fresh water are common and the tanks and barrels could be filled by a bucket brigade in an hour or two

camera, set out for the main herd, while I in the power dory headed for the smaller band. There was but little finesse to our plan, for each party ran up to within a short distance of the walrus and then attempted to pick out satisfactory specimens and drop them on the ice before the mad scramble carried the animals into the water. At the first shot the sleepy monsters, that had paid no attention to the noise of the motor, reared their heads and with one accord fell or slid into the sea. In a twinkling the shapeless mass of bodies had dissolved into individuals which took the most direct course for the edge of the ice. All, that is, except the few that had been struck in a vital spot by bullets.

Once in the water, the walrus collected into a compact band and began a leisurely retreat, coming to the surface frequently and rolling sullen angry eyes back at the strange creatures who had so rudely disturbed them. It was possible to drive the boat right up to the milling walrus and to select a few more specimens to supplement those secured on the ice, and this we proceeded to do, making certain of a stricken animal by harpooning it and attaching the line to a float. In doing this there was some risk, for a walrus, by accident or intention, might drive a tusk through the launch or rise beneath the boat and overturn it. The Stoll-McCracken party had walrus rising close alongside and were kept busy for a few exciting moments when it looked as if some of the beasts would put tusks over the gunwhale. The engine of my launch was out of order this day and it died completely when we were right among the walrus, but none of the animals made hostile demonstrations. Incidentally, this engine trouble so hampered my ability to move about, that I soon ceased to take a very active part in the hunt, which was

WATCHING FROM THE BOW FOR WALRUS
All of the activity on deck drew to a focus at the bow of the schooner. Here a constant watch was maintained for walrus, polar bear, and seal

just as well since the other party secured all the animals necessary for our purpose, that is, all the females, yearlings, and calves, for these walrus were all of this category and we saw no bulls.

The schooner came up to the scene and the launches ferried the heavy carcasses over to it. A tackle was rigged and slings put around the walrus which were hoisted up on to the deck. There was great rejoicing that such fine material for the group had been secured, for we had imagined that we might have to search a long time for the young walrus. The cows were good-sized, typical animals, and the immature were represented by a yearling bull and two calves of the year. Now all that was needed to complete the group requirements were two prime bull walrus. As it turned out, this was to be much more of a task than we anticipated.

LOOKING AFT ALONG THE DECK

An ample supply of oil for the Diesel engine had to be carried and a large part of this had to be stowed on deck. This, together with cans of gasoline, barrels of water, launches, et cetera, filled almost all of the deck space. When the schooner ran aground and this had to be all set ashore, the party realized to the full just how much it weighed

For the next seventeen days the schooner wandered about the Arctic Ocean. From a spot northwest of Point Barrow, Alaska, nearly 73° north latitude, west nearly to Wrangel Island, and south to the Diomedes and East Cape, Siberia, we cruised and scanned the ice for walrus. Luck was against us and the rare, fleeting glimpses of solitary animals never developed into a hunting opportunity. Strong winds arose and shifted the ice fields almost on an hour's notice. Depressing fogs enveloped us with but scant warning, and although they usually lifted soon, we could not venture very far inside the ice field when the visibility was poor. Following a day or two of high wind and stormy seas, we ran close to the ice not far off the Siberian coast, presumably about Cape Serdze Kamen, and were tantalized by the sight of huge bull walrus riding the crests of the waves. It was far too rough to put over a small boat or attempt to

BULL WALRUS ASLEEP ON THE ICE

These are the walrus shot by Mr. and Mrs. Stoll and the photograph was taken from the approaching launch. Unable to assume an upright position because he would cut into the field of a motion picture machine, the photographer had to expose more or less by guess

THE END OF A SUCCESSFUL STALK

The bull walrus killed by Mr. and Mrs. Stoll have unusually large tusks. The larger of the two shown here has a fine symmetrical pair 31 inches long. These specimens are to be mounted for exhibition in the American Museum

AN ESKIMO BILLIKIN

The modern Eskimo has created a two-man skin boat which serves a purpose intermediate between the large umiak and one-man kyak. Having no traditional name for it, he has borrowed a foreign word and calls it a "billikin"

MR. STOLL AND MR. JAQUES ON THE "PROMENADE DECK"

During clement weather the personnel spent most of the daylight hours on deck. Mr. Stoll (wearing glasses) usually was to be found up near the bow watching for walrus and bear, while Jaques favored the stern and studied the birds

go after the quarry and we had to pass on, hoping for another encounter when the weather moderated.

Low visibility prevented the Captain from locating our position on the map as he slowly retreated southward, feeling for the lee of the ice and seeking for the southern limit of the field. There was the possibility that the "Morrissey" might be caught in a pocket of the ice if the descending wings of the eastern and western fields beat us to Bering Strait and consolidated before we got there. The wind had been steadily from the northward and the ice was moving rapidly southward. We knew that the western ice was unusually far south for the time of the year. We hoped that the eastern pack had not advanced so rapidly. On the morning of August 27 we were close to the Siberian coast and with the Diomede Islands in sight to the southward. Everywhere between us and Siberia stretched closely packed ice, while toward the Diomedes and Bering Strait there was no visible opening through the ice pans. As far as we could see the Strait was packed with solid ice!

CAPTAIN BARTLETT SHOOTS THE SUN

Captain "Bob" Bartlett never missed an opportunity to "take the sun." The constant presence of clouds and fog force a skipper to keep his position on the chart up to the minute, for he does not know when or for how long they may hide the sun

All that day the schooner made the best speed it could to the eastward, skirting the ice, while up in the barrel the Captain looked for the eastern limits of the field. There was considerable relief when it was finally discovered that the Strait was open from Cape Prince of Wales almost to Little Diomede. None of us liked the prospect of having to spend the winter icebound in a small schooner, and while a knowledge of what could be expected told us that a southerly wind would soon clear the ice out of the Strait, it was a more comfortable feeling late that afternoon to be on the southern flank of the ice field with open water between us and civilization and looking out on the ice from the safer side.

A FUR SEAL PUP

The fur seals begin to come to the Pribilof Islands in May and leave in November. Early in this season the pups are born, a single young to a mother, and by the end of the season they have grown enough to be able to accompany the old seals on their long migration at sea

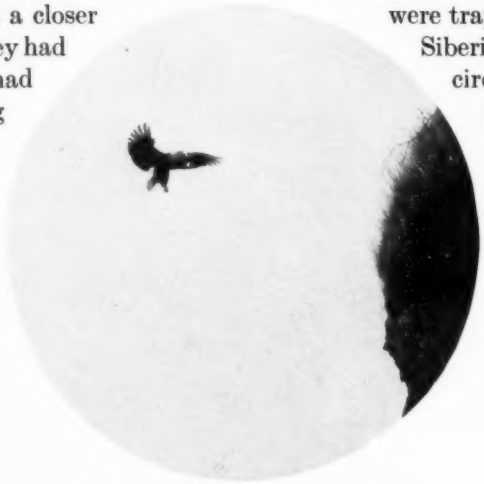
A BULL FUR SEAL AT ST. GEORGE

At St. George Island, one of the Pribilofs, the expedition spent a morning visiting the large rookery there. The seals are not alarmed very much at the approach of man. On the contrary, the male seals are aggressive, charging fiercely if a visitor comes too close to the harem

As luck would have it, we ran across a large herd of walrus this same afternoon. They had come southward with the ice and now that the wind had gone down and the sun was out (this day had been exceptionally clear and summer-like for the Arctic) they were sleeping on the ice and making the most of the good weather. It was too near nightfall to go after our specimens so we spent the night hove-to near by. In the morning the animals had moved off, seemingly to the westward, and thither the schooner followed.

The animals were relocated on the ice on August 30 and, although the wind was rising and blowing on to the ice, so that we were on what is termed the weather edge, not a nice place to be with low-powered craft, the launch was put overside and an attempt made to complete our group. Mr. and Mrs. Stoll had the good fortune to make a perfect stalk on two splendid, big, bull walrus asleep on a small pan of ice. McCracken and I took photographs as the launch crept up to the pair, and when the shots were fired and both animals collapsed before they could move off the ice, we hurried to get a closer view to ascertain if they had tusks as large as we had hoped for. Our long search was well repaid, for the bulls were far finer than the average, and one in particular had exceptionally large and well-shaped tusks. The weight of these bulls taxed our tackle to the utmost and stalled the winch. Even the skins were so heavy it required three or four men with block and tackle to move them. When these animals are mounted and the completed group occupies one of the large cases in the Hall of Ocean Life, the full and adequate representation of the Pacific walrus will be the sole result of Mr. Stoll's determination, in the face of obstacles and discouragements, to secure a satisfactory group, if the expedition did nothing else all summer.

As a matter of fact, the securing of the group did exhaust the short Arctic season, and after a brief and fruitless attempt to get several more bull walrus as personal trophies, the schooner left the ice on September 3 and began the long run southward. It was a cause of great regret in leaving the Arctic Ocean that not even one polar bear had been sighted. On the other hand, the season was said to be an unusual one, the ice had closed in very early, one schooner had been driven ashore by ice near Point Barrow, and one or two other vessels were trapped by ice along the Siberian side. Under the circumstances we might count ourselves fortunate in having accomplished our major purpose without any undue mishap.



A BALD EAGLE COMING IN TO ITS NEST

Bald eagles are abundant in southern Alaska and out along the Alaskan Peninsula. They are remarkably fearless and fly close to man, failing to recognize him as a potential danger. Their nests are found on every high or detached spire of rock

"THE LONG BROWN PATH"

HOW NATURE PLANTS HER FLOWERS

The Many Ways That Flowers and Trees Scatter Their Seeds—How the Wind Aids Some—How Birds and Animals Carry Others—The Extraordinary Diversity of These Natural Methods

By CLYDE FISHER
Curator of Visual Instruction, American Museum
PHOTOGRAPHS BY THE AUTHOR

Flower in the crannied wall,
I pluck you out of the crannies;—
I hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all,
I should know what God and man is.

—TENNYSON.

THE love of beauty seems to be innate. There seems to have been born in every human mind a love of the beautiful in one form or another, and surely in most persons this embraces our wild flowers in their great variety of form and color and fragrance. Some of these flowers are to be looked for along roadsides and in cultivated meadows, others in marshes and bogs, others in shady woods, and still others on mountain tops. Some plants grow only in acid soil, while others are to be found only in limestone regions. But wherever they occur, they attract our attention because of their beauty.

For some reason, perhaps not easy to explain, our early associations strongly influence our appreciation of wild flowers and birds and other objects of nature. This significant fact is a plea for arousing and cultivating an interest in the outdoors at an early age. Burroughs speaks of the "memory-stirring" note of the meadowlark.

Plants live as animals live. Many lower forms have powers of locomotion highly developed. Some plants, for example the wheat-rust, a parasite, seem to migrate in a way analagous to the seasonal migration of animals. The insectivorous plants entrap insects and digest them as some animals do. Here belong the pitcher-plants, the sundews, the butterworts, the bladderworts, and Venus's fly-trap. Some plants, like the

DANDELION'S SPHERE OF PARACHUTES
After the flowers fade and while the seeds are ripening, the hollow stalk grows longer, thus lifting the ball of seeds with their parachutes so that they may be more effectively wafted away on the breeze

slime molds or myxomycetes, have a plant phase and an animal phase. In fact, some biologists consider these organisms animals and call them mycetozoa. This recalls a fascinating essay by Huxley on the borderland between the vegetable and animal kingdoms.

Many of our conspicuous flowering plants have extended their range, have traveled far in historic time. Most of the so-called weeds of our roadsides and cultivated fields in eastern United States have been introduced from the Old World. This is true of yarrow, dandelion, daisy, bouncing Bet, butter-and-eggs, corn-cockle, shepherd's-purse, Queen-Anne's lace, viper's bugloss, and many others. Occasionally one has come from the western United States, as black-eyed or brown-eyed Susan, and occasionally one comes from South America, as *Galinsoga*, a small weed with inconspicuous, composite flowers.

This habit of traveling, which is universal among plants, is obviously an advantage to the individual species, for if all the seeds produced by a given plant would fall straight down to the ground and were allowed to remain and to germinate there, the resultant overcrowding can easily be imagined. Of course, this does not occur in any absolute sense, although there are some approaches to it. In practically all cases, however, there are means of scattering the seeds far and wide. In many instances clever devices astonishing in their effectiveness have been developed by the plants themselves. In other cases there seem to be no special devices. It is doubtful whether it is generally appreciated that myriads of seeds are moved, and to long distances in the aggregate, by the water that falls as rain, while it is flowing over the surface of the earth before it has collected into the recognized brooks and larger streams.

One of the commonest and most frequently observed methods of seed-dispersal is that dependent upon the wind, and there are at least three different devices for the accomplishment of this. First, are those with *flying-hairs*, for example, the dandelion. Every one is familiar with the wonderful little parachutes, one attached to each seed, and all arranged in a ball on the scape that previously bore the head of flowers, which is known to the child as the dandelion flower.

> *"The dandelion's coin of gold*
> *Anew is minted on the lawn."*

But how many of us have observed that the scape or stalk of the dandelion grows much longer between the time of flowering and the ripening of the seed? This lengthening serves to lift the head of fruits or the ball of seeds with the parachutes up above the grass and other surrounding plants, so that the wind may waft them away more effectively.

Similar to the dandelion's flying appendages are those of colt's-foot, and perhaps most astonishingly complex and beautiful of all flying devices of the dandelion type are those of goat's-beard and salsify.

We find flying-hairs of a different type in willows, milkweeds, goldenrods, asters, thistles, and very greatly developed in cotton. The lint or fibers of cotton, which are woven into cloth, are the flying-hairs from the cotton-seeds.

Just as dependent upon the wind is a great group of plants whose fruits or seeds have *wings*. Examples of these are the maples, the elms, the ashes, trumpet-flower, cross-vine, and ailanthus. One has only to toss up a handful of maple seeds or ailanthus seeds when a breeze is blowing to observe how the wings function.

The *tumble-weeds* and tumble-grasses constitute a third group of plants which depend upon the wind to scatter their seeds. All of the tumble-weeds are more or less globular in shape, and have the habit, when the seeds are nearly ripe, of

TROUT-LILY BESIDE THE BROOK

John Burroughs referred to this spring flower as the trout-lily or fawn-lily, because of the mottled or spotted leaves. An additional reason for the former name is its frequent habit of growing along trout streams

TWIN-FLOWER OF THE NORTH WOODS

The European form of this flower, *Linnæa borealis*, was named for the great Swedish botanist, Linnæus. He admired its modest, retiring habits, and its delicate fragrance

A BEAUTIFUL MEMBER OF THE CAMELLIA OR TEA FAMILY

Mountain Stewartia, a shrub whose large, showy flowers with cream-colored petals attract attention along the mountain streams from Kentucky to Georgia

GRAY SQUIRREL BURYING A NUT

The seeds of many of our nut-bearing forest trees are without doubt transported and planted by mice, chipmunks, and squirrels

WATER-HYACINTH

This floating plant is often blown about on lakes or slow-moving streams in Florida, where it has been a nuisance to navigation

TOUCH-ME-NOT OR JEWEL-WEED
The touch-me-not has explosive fruits, the turgid capsules bursting open and the valves curling up with sufficient energy to throw the seeds a considerable distance

breaking loose from the ground. These light, rolling masses are then blown across the prairies or fields by the wind. Not all the seed-capsules are opened at once, but they are opened gradually, thus scattering the seeds as the plant tumbles along. Besides the common western tumble-weed, there are several close relatives, such as the ghost-plant or white pig-weed. A relative of the Indian-turnip of the Great Plains, and the Russian thistle, and several grasses are tumble-weeds that scatter their seeds in this way.

The coconut, which is cultivated around the world in the tropical regions, is a classical example of a *water-borne* seed. The outer fibrous husk with a water-proof coat on the outside makes this possible. So often this tree overhangs the water along the borders of islands or other tropical shores, and this habit makes the method a practicable one in nature. Many of our local aquatic plants, such as arrow-head, and the white water-lily, have their seeds transported by water. We do not include the many plants whose seeds are washed considerable distances by rain-water, as mentioned above.

Some plants depend upon both the *wind* and the *water* in an interesting way. Examples are the Egyptian lotus and the native American lotus. In the lotus the flower is borne on a stiff stem that projects a foot or so above the water. The seeds, which resemble acorns, develop in depressions in the flat upper face of an enlarged top-shaped receptacle. The flower-stalk later supports this receptacle, holding it firmly above the water. The seeds cannot fall out of the receptacle because the cavities open upward, and they are only released when the wind blows hard enough, with the aid of the waves it causes, to shake the receptacle violently enough to throw the seeds out. In this way it works like a certain type of boy's sling-shot, and the seeds are thrown quite a distance.

Many plants have *explosive fruits*, and there is great variety in the ways in which this is accomplished. In the witch-hazel the seed-capsule bursts open and the two seeds are thrown some distance. In the

Virginia knotweed there is a cushion of elastic cells at the base of each fruit, which throw the ripe fruit or seed a distance of several feet when the hook, formed by the dried style of the flower, is pressed. In the squirting cucumber the fruit becomes very turgid upon ripening, and finally the pressure is great enough to push the stem out, leaving a hole through the rind. The seeds, which are held in suspension in the liquid contents of the fruit, are squirted out with the liquid through the hole at the stem-end of the cucumber.

The violets, the wild geraniums or crane's-bills, and many members of the bean family have explosive fruits, and for different reasons.

Plants, whose seeds are *carried by animals*, may be divided into several groups.

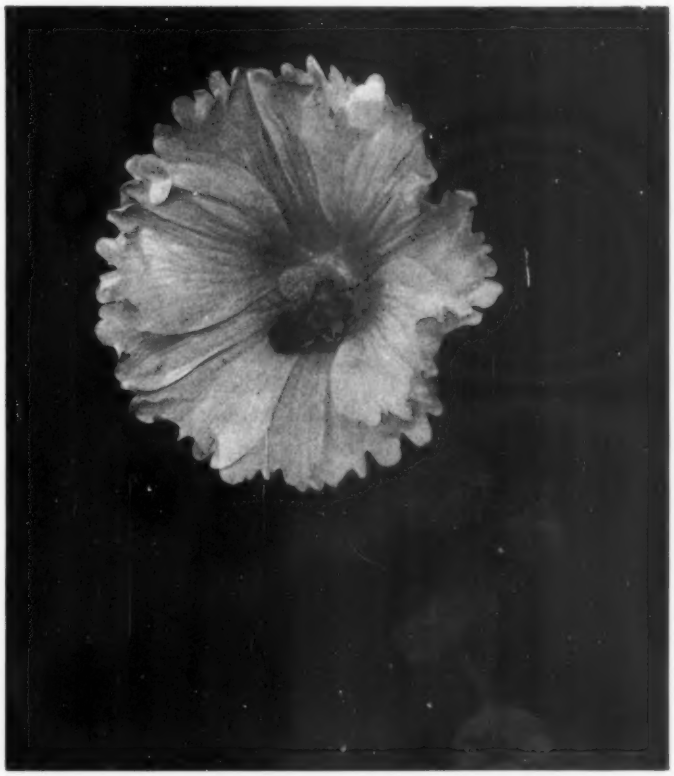
First: Fruits or seeds with hooks, as in burdock, cockle-bur, stick-tights, Spanish-needles, tick-trefoil, hoarhound, sand-bur, and many others. Everyone is familiar with the way these burs or hooked fruits are carried on the clothing of human animals, in the mane and foretops of horses, in the wool of sheep, and on the coats of fur-bearing animals.

Second: Seeds of plants are carried long distances on the toes of migrating waterfowl, as Darwin proved in an experiment which he described.

Third: Fleshy fruits containing seeds, which are indigestible, are eaten by birds and animals, and transported far from the parent plants. Probably many of the wild black cherry trees which spring up along our fences, came from seeds carried in this way. Robins and starlings carry not only cherry-seeds but also the seeds of the flowering dogwood, and other trees and shrubs.

Fourth: Certain birds store away or hide seeds,—for example the blue-jay hides or puts away acorns in various places, sometimes in abandoned birds' nests; the tufted titmouse hides or places pine seeds in the chinks of bark of trees; the California woodpecker regularly stores acorns in holes which it drills in tree-trunks or in posts. In many cases these seeds are eaten by the birds, but there is no doubt that some of them reach the soil, perhaps by being washed down by rain, and germinate.

Fifth: Many rodents store up nuts for



BUMBLEBEE ASLEEP IN THE FLOWER OF A HOLLYHOCK
Photographed on an autumn morning before the sun had warmed the bee into activity

BROWN-EYED SUSAN

The brown-eyed Susan, or black-eyed Susan, has been introduced from the western United States

QUEEN-ANNE'S LACE

The flat-topped umbel of Queen-Anne's lace or wild carrot usually has in the center an aborted flower, brown in color. By the time the seeds are ripe the umbel has become concave and dense, closely resembling a bird's nest

PARTRIDGE BERRY

This may be called the Siamese twins among flowers, for two flowers develop into one berry having one stem and two blossom-scars

WIND-BLOWN PODS OF THE MILKWEED

The seeds of the milkweed are scattered by the wind

food in positions well adapted to lead to planting. One of the best examples is the gray squirrel which buries many nuts each autumn,—one nut at a place. After a gray squirrel has buried fifty or one hundred nuts, let us suppose that the squirrel comes to some tragic end,—he may be shot by a hunter or killed by a dog. Then what is likely to happen to the buried nuts? They are in excellent position for germination. In case the squirrel were not killed, it is altogether possible that it would not find and dig up all the nuts it has buried. Those not found would be in fine position to grow.

It is believed that squirrels and mice have a great deal to do with transporting and planting the seeds (nuts) of forest trees.

In this brief article only a few of nature's methods of scattering seeds can be mentioned or described. There are many others, and every one is interesting.

"Happy is he who understands the causes of things."

A PARENT CEDAR AND ITS CHILDREN
The overcrowding due to the lack of efficient means of scattering the seeds is well illustrated by this old red cedar and its offspring

Royal Flame Trees Silhouetted Against a Tropical Sunset

NEW CALEDONIA

A MODERN FRAGMENT OF THE ANCIENT WORLD

An Island in the South Pacific Ocean so Isolated for Ages that Its Plants and Animals and Landscapes Carry One Back to a Past Geological Age—A Setting Almost Like That of a Different Planet

By WILMATTE PORTER COCKERELL

THE silhouettes of flamboyant trees will always be associated in our minds with the island of New Caledonia. This tree, well called the royal flame tree, and voted by many plant lovers the most beautiful tree in the world, is a native of Madagascar, but has been planted all over the tropics, and in New Caledonia the French have planted hundreds—planted them in long avenues, in groups in gardens, or perhaps just single trees near a lake or pool so placed that the lovely shadow may be reflected in the water.

When Professor Cockerell and I were deciding upon an island to explore, we chose New Caledonia because, having many forms, both plants and animals, peculiar to the island, it is of the greatest interest to naturalists. Island areas often throw great light on the history of this old world of ours, and though New Caledonia has been pretty well explored, we hoped there might be some new things in our special field, the solitary bees, and the snails, but we went rather as students than collectors. Some of the questions over which we pondered were: Why are there no mammals in the island except bats, no snakes except sea snakes, no amphibians except the frogs that the French have introduced, few bees, few butterflies, but many species of grasshopper-like insects? The island is continental, the geologists tell us, but the continent of which it was a part must have been broken up in early geological times, though there were connections later with parts of this old continent. Well, it was all tremendously interesting!

I must confess that before we reached Australia, New Caledonia was little more than a name to me, although it is the second largest of the Pacific Islands,

A HUT AT ST. LOUIS, NEW CALEDONIA
Many laborers have been imported from Java and French Indo China and these perform most of the work on the island. Huts such as this, made largely of grass, are almost universal among these people

New Zealand being first. I had learned in my geography years ago that New Caledonia belonged to the French and that it was used as a penal settlement, and later, when I read the life of that intrepid explorer, Captain Cook, I found that it was he who discovered and named the island, calling it New Caledonia because of its physical resemblance to Scotland.

Like the largest of the Madeira Islands, New Caledonia was not discovered until years after the smaller islands of the archipelago (New Caledonia and outliers and the Loyalties) were known. De Bougainville, sailing south from the New Hebrides, noticed coconuts and branches floating in the sea around him, and this he told to Cook who landed at Balade on the northeast coast September 4, 1774. The name of Bougainville is well known to plant lovers because of the beautiful plants belonging to the genus *Bougainvillea*, vines grown in the North as pot plants in the greenhouses, and giving a riot of color over trees, or as hedges and fences in tropical and subtropical countries. It was a delight to see the bougainvilleas in New Caledonia, and to remember that, though the plant is South American, even in this far-away island which Bougainville was the first to picture in imagination though not actually to discover, his name is linked with one of the common garden plants.

The history of New Caledonia is full of interest through its period of discovery and exploration; through the period of missionary activity beginning about 1840; the period when the island was a French penal settlement; and the last thirty years, which might be called the period of commercial development.

Since 1853 New Caledonia has been a French colony, although almost immediately after its discovery the French missionaries began their work, and its annexation to France was largely due to their influence. The natural history of the island owes much to these early missionaries. One of them, Father Montrouzier, made extensive collections and described and named many insects and snails—in fact was a sort of Linnæus of the island and its outliers. We visited

the church where he worked for many years, and our friends tried to get permission to copy his photograph, and to record something of his life at St. Louis for this article, but the resident fathers were more interested in piety than in Montrouzier's biological pursuits.

The plants of the island are quite as interesting as the animals, and carry us even farther back in the making of land areas. Hardly fifteen years ago Compton from England spent three years on the island studying the plant life. He made a collection of 830 flowering plants, of which 230 were new species with 10 new genera. In the discussion of Compton's report, Doctor Seward, of Cambridge, said that the plants of New Caledonia carry us further back in the history of plant life than the plants of any other region of the earth's surface. We found that wandering through the "scrub" was like being on a different planet or being carried back into a past geological age, so like was the landscape to pictures of other ages that one sees in geologies.

A superficial survey of plant forms is interesting, but gives little idea of the strangeness of parts of the "bush" of New Caledonia, a "bush" most like that of the Mountains of the Moon in Africa.

A coniferous tree that has been of great interest since the discovery of the island, is *Araucaria cookii*, named for Captain Cook. It grows to a height of more than 200 feet with very straight and imposing shafts. On the approach of Captain Cook's vessel to the Isle of Pines, these trees were mistaken for columns of basalt, so different is their form from that of ordinary trees. Even Banks and Solander, the naturalists of the expedition, insisted that the columns were mineral, after other members of the expedition, among them the great Captain, had conceded that the curious columns must be trees. And although we were quite familiar with the historical account, and had even seen pictures of this remarkable tree, we had the same

A GARDEN AT A RAILWAY STATION

These flame trees, two of which are shown here, are said by many to be among the most beautiful trees in the world. They have been introduced from Madagascar

illusion that they must be mineral columns, when we saw them for the first time.

The island has a native *Cycas*, a very beautiful species which we saw in the bush near Bourail; fourteen kinds of *Casurina* trees; no *Eucalyptus* trees, but great forests of the beautiful niaouli trees which are near relatives of the eucalyptus though probably more primitive in their characters; four kinds of endemic palms and several species of endemic mosses, and since mosses are so widespread, this is rather specially significant. There are many species of ferns and orchids so that in places the bush looks very like one of the great hothouses of Kew. These are only a few of the ways in which the native plants interest the traveler, and give ideas about the history of the world to the naturalist.

As in Australia, the introduced plants have completely changed the landscape in places—guavas and oranges grow wild in such numbers that it is hoped to make them of commercial value. The introduced grasses have become such a pest that sheep raising is no longer profitable, since the seeds of the grasses get into the wool and make it almost impossible to clean. Many species of introduced weeds flourish; we saw the common dandelion which is such a pest in Colorado. There were places where the lantanas were almost as thick as in the Hawaiian Islands.

The principal crops are coffee, coconuts, and rice, and though we saw a few very good fields of sugar cane, we were told that the weather made cane growing

A NATIVE OF NEW CALEDONIA

European colonists have often found that the natives of colonized lands have not lent themselves to the white man's ways. This is true of these natives. They are not, in the European's eyes, "good workers," and the French of New Caledonia have been forced to obtain the laborers they require from other East Indian lands

A CHARACTERISTIC SCENE IN THE INTERIOR
The huts shown in this photograph were occupied by Indo Chinese imported to New Caledonia. The "niaoli" trees and the "bush" shown are typical of the island

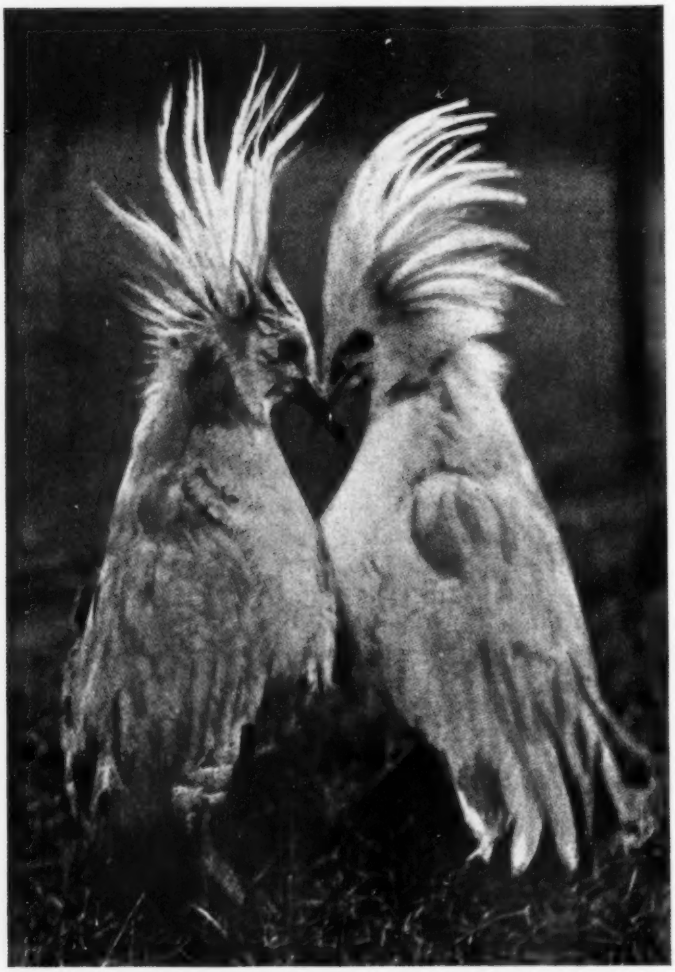
difficult and that the fields we saw were grown for the purpose of making rum.

The climate is variable, and instead of having wet and dry seasons, New Caledonia has wet and dry years. In places plants for irrigation have been installed, but often the same land that is irrigated one year must be drained the next, making all agricultural work uncertain and costly. Some of the coastal islands have valuable deposits of guano.

The greatest wealth of the island is in its mines of chrome, nickel, cobalt, copper, lead, and there is some silver and gold. The chrome mines are said to be the largest in the world. Some profitable timber cutting is carried on, and we found a timber company from Australia taking out the valuable Kauri pine trees from the high country. This company has a small railroad running up to the region of their concession, and as we were very anxious to get into the hill regions, we tried to get permission to travel on this road. Unfortunately, we could only go by courtesy of the manager of the sawmill, Mr. Howard Ross, but he always pleaded that he was too busy, though we felt that his occupations should have left some time for giving help to a visiting naturalist. We received so much help everywhere that Mr. Ross's attitude was very disappointing, for in the high forests we should certainly have found new forms of the splendid *Placostylus* (the fine land snails abounding in the island) and just possibly have seen the wonder bird of the island, the world-famous kagu.

We found some of the residents interested in natural history, particularly in corals, shellfish, fish, and birds, and our host, M. Paul Bloc at Plum Farm, was a very efficient collector and a delightful guide. Dr. Jean Risbec was the only naturalist we met. He was formerly a teacher but is now employed by the government to investigate sea life. He is the author of a very beautiful book on sea slugs or nudibranchs, and we had a delightful afternoon with him looking over his drawings and discussing the distribution of these very fascinating little sea animals. He told us that he

had collected and described about seventy new species from the reefs of New Caledonia and outliers, and hoped to find many more. The beautiful nautilus shells along the shore were a delight to us. We also found the cuttle bones of two species of squid, which proved to be of especial interest to Mr. Iredale of the Sydney Museum. We visited the factory where pearl disks were being cut from the *Trocas* shells. Tons of these disks are sent to France, where the process of turning them into pearl buttons is completed. Mr. Levin, a young American, who came as a visitor to the islands but who was staying to install the machinery for making jelly from the wild guavas and marmalade from the wild oranges, took us about in his car and gave us help in many ways.



Photograph by D. Seth-Smith

KAGUS IN CAPTIVITY

These rare birds have been known to live a dozen years or more in confinement, and their voices have been compared to the sounds made by puppies. Though the external appearance is heron-like, anatomical studies have shown them to be more nearly allied to cranes. They are flightless birds about the size of small chickens, and though their long legs make it possible for them to run rapidly, they seldom do so

All along the coast and on the near-by islands there are species of the large land snails belonging to the genus *Placostylus*. These snails are esteemed as delicacies both by the natives and the French, so it was easy to get good series of the different forms. Snails are perhaps the best animals to show the history of land building, since they have such limited powers of locomotion.

The native people are of two very easily recognized groups, although in recent years there has been much intermarriage. We thought the Kanaka children delightful. In many ways it is much easier to be a child in a primitive cultural group, for reasons quite apparent even to a casual observer. Like our Indians, the Kanakas are seldom good workers, so that the French import Javanese and Tonkinese to do the work of the island.

There were many interesting birds. Among them were the honey

THE REEF-PROTECTED BEACH OF NEW CALEDONIA
The coral reef surrounding the island of New Caledonia is second in size only to the Great Australian Barrier Reef

eaters which take the place of the humming birds of the Americas. These were especially attractive, both with their bright colors and active movements as they visited the flowers of shrubs and trees, and took their part in the evening bird chorus as I stayed in the first darkness among the niaoli trees near Plum Farm. What a sight must be the large wide-spreading trees with sheets of crimson flowers alive with active, noisy lorikeets and beautiful honey eaters! Sarasin and Roux, celebrated Swiss naturalists, whose reports on the fauna of the island are classical, list seven species of these delightful little birds, and Doctor Leach, a recent ornithological visitor from Australia, recognized five of these species.

Along the shore we saw several species of plovers, and it seemed very amazing that many of them had come from their breeding grounds in Siberia. The long trek of bird migrants always stirs one's appreciation and wonder, but a trek from Siberia to the far-away New Caledonia is almost beyond belief!

The most famous bird of New Caledonia is the unique kagu, a bird with beautiful wide-spreading wings, though flightless, and long legs which it seldom uses for running. When attacked by an enemy, it settles in the bush and covers its body with its wings and erects its splendid crest. Of course it is an easy prey for dogs or hunters.

Besides the usual dogs kept as pets, many dogs are kept to hunt deer, an Indian stag introduced several years ago and now considered one of the worst of pests, though we found that venison was much appreciated as food and is even canned for export. So it would seem that the success of the deer is likely to cause the extinction of the kagu, so long one of the wonders of New Caledonia. The bird was even given a place on the stamps of the country a few years ago.

The kagu is an ancient, generalized type, and is confined to this bit of the old southern continent which some naturalists call Gondwanaland. Three such birds are known: the kagu, the sun bitterns of South America, and the peculiar *Mesites* of Madagascar. At one time these birds were grouped together, but

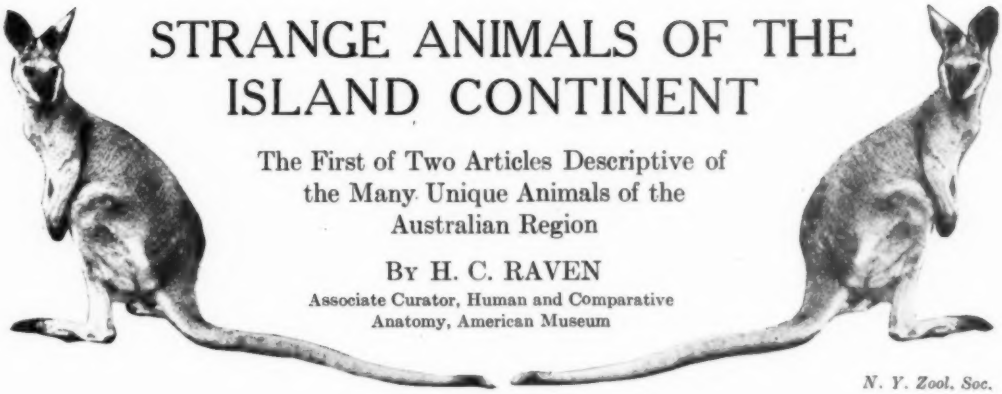
now the Madagascar bird is placed with the scratchers. The real systematic place of these aberrant types is still the subject of much speculation.

The kagu is a delicate blue-gray, with its feathers very loosely webbed, giving the crest a flower-like appearance. The bill and legs are red-orange. The bird is about the size of a small hen, though the body has quite a different shape, and the legs are long. We despaired of seeing the bird in its wild state, for the hunters have driven it back into the mountain areas, but fortunately people sometimes keep kagus as pets, and we went to see the two belonging to Mrs. Jackson. Their owner was not at home, but the black servant took great pride in showing us the birds. This she said was Monsieur Kagu and that was his wife Madame Kagu. When asked if they would breed in captivity she said: "Oui, oui, and that is the eldest son, young Monsieur Kagu," pointing to a small gray heron wandering about the yard (a bird of quite a different group). Only one egg is laid and probably only one young is raised each year, though the natives have an amusing myth of the hen bird leaving an egg behind for the jealous cock when she scuttles into the bush with her newly hatched chick.

A. J. Campbell of Sydney, Australia, has had a chick hatched in confinement, the period of incubation being thirty-six days. The young is described as a fluffy ball with a big heavy head, the color being dark brown with light fawn markings.

Reluctantly we left this old corner of the broken-up continent Gondwanaland, but felt that it had come to be a very real continent to us. Much work must be done with all groups of animals and plants, as well as with fossils and with structural geology, before we can define the boundaries of Gondwanaland or even picture in imagination the vicissitudes through which it must have passed.

"THE PERCHED ROCK" NEAR BOURAIL
Many swallows, locally called "swiftlets," nest about this rock and in the arch of the cave from which this photograph was taken



STRANGE ANIMALS OF THE ISLAND CONTINENT

The First of Two Articles Descriptive of the Many Unique Animals of the Australian Region

By H. C. RAVEN

Associate Curator, Human and Comparative Anatomy, American Museum

N. Y. Zool. Soc.

CAMPED high in the mountains of Central Celebes, I was sitting with my three Malayan companions close to a fire built on the floor of a palm-thatched hut. We heard an animal up in a treetop in the dense mist and darkness outside, give and repeat its faint call —"tuc-tuc-tuc-tuc---- tuc-tuc-tuc-tuc." In the low country of this East Indian island after dark, the buzzing and humming of the insects of the jungle would probably have made it impossible to hear such a faint call; not so, however, in this cool, moss-covered forest between six and seven thousand feet altitude. One of my natives was a Toradja boy about ten or eleven years old, and it was he, speaking in the Malay he had learned during the three months he had been with us, who said the voice we heard was that of the "timpausu," an animal which climbed about in the treetops, ate leaves and fruits, and carried its young in a pocket.

A few days later, while we were eating our midday meal, one of the boys glanced down the steep slope of the mountain and chanced to see something moving about in a treetop about a hundred yards away. The small boy, Sempa, was sent to see what was there. He stalked quietly under cover of the dense vegetation and then called back that the animal was a timpausu, the largest he had ever seen. I went immediately to the spot and found that this nocturnal animal was apparently foregoing his usual daily sleep in order to feed on the fruit of a tall forest tree.

I told Sempa to climb the tree and drive the timpausu down where we might capture it, but I was surprised when, after a little persuasion on my part, Sempa began to fasten his feet together for the climb up the smooth trunk. He was clad only in a loin cloth, but of course carried his *parang* in a wooden sheath that was always fastened about his waist. When he reached the branch on which the timpausu rested, the animal hissed at him and backed out on the branch, away from the trunk. Sempa carried several pieces of rattan with which to attempt to snare the timpausu, but it was not a very easy matter for him to get the noose over its head and still more difficult to draw it taut, for as soon as the animal felt the rattan he scratched it off. Finally, however, Sempa with a wonderful display of agility managed to snare the beast by the head, body, and feet, so that it was completely helpless. It was then lowered to us.

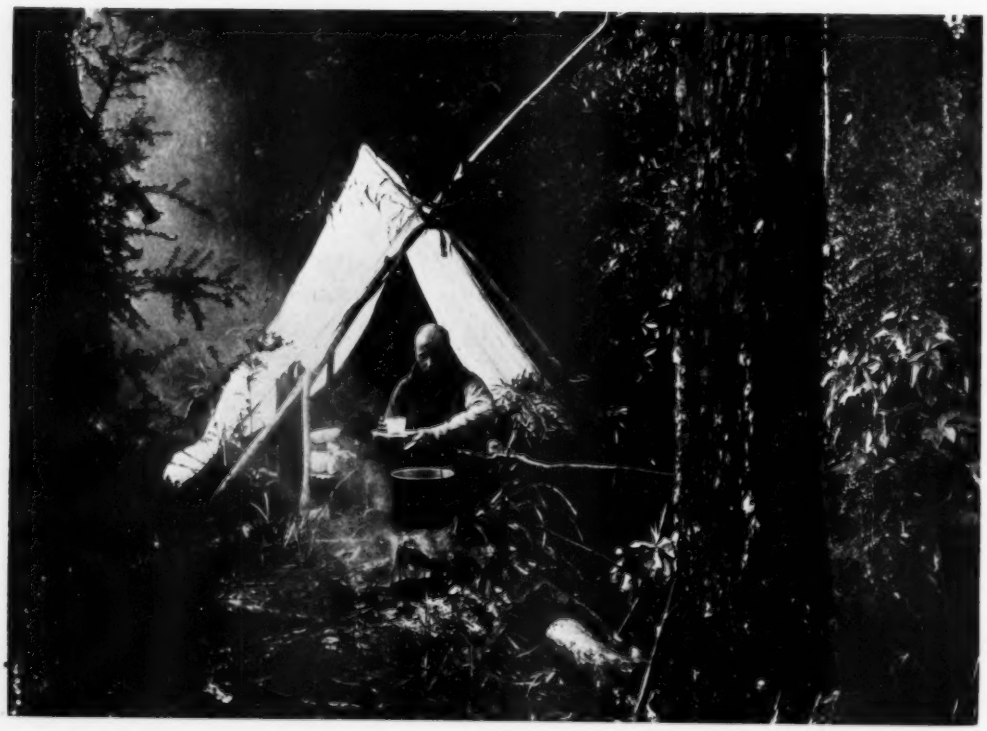
This marsupial proved to be of a species new to science and was named *Phalanger furvus* by Miller and Hollister. It was the third species to be described from Celebes and is the largest living phalanger. The other two species are fairly common in some parts of the island. The natives have for centuries killed them for food, and until comparatively recent times, for their scent or musk glands, that are like similar glands in the civet. These

HUNTING FOR PHALANGERS

The Australian aboriginal, or Black fellow, climbs trees with the aid of a piece of bark or a vine that he loops about the trunk. He hunts for the phalangers in holes in the trunk and in the branches

A FOREST CAMP

The expedition made short trips into the dense "scrub" between the top of the escarpment and the coast. Here they collected marsupials not found in the open eucalyptus forest



AUSTRALIAN ABORIGINAL HUTS

These crude dwellings are covered with eucalyptus bark and grass. The natives who occupy them live upon wild fruits and grass seeds and with the aid of dingoes, or wild dogs which they have domesticated, hunt various marsupials

FELLING A BIG TREE IN ORDER TO CATCH A SMALL ANIMAL

Trees three feet or more in diameter were felled in the search for the pygmy flying phalanger—a creature so tiny that a whole family can be held in the palm of one's hand

have found their way into the hands of Buginese, Arab, and Chinese traders on the coast just as wild beeswax, copal, rattan, and other products from the jungle have done.

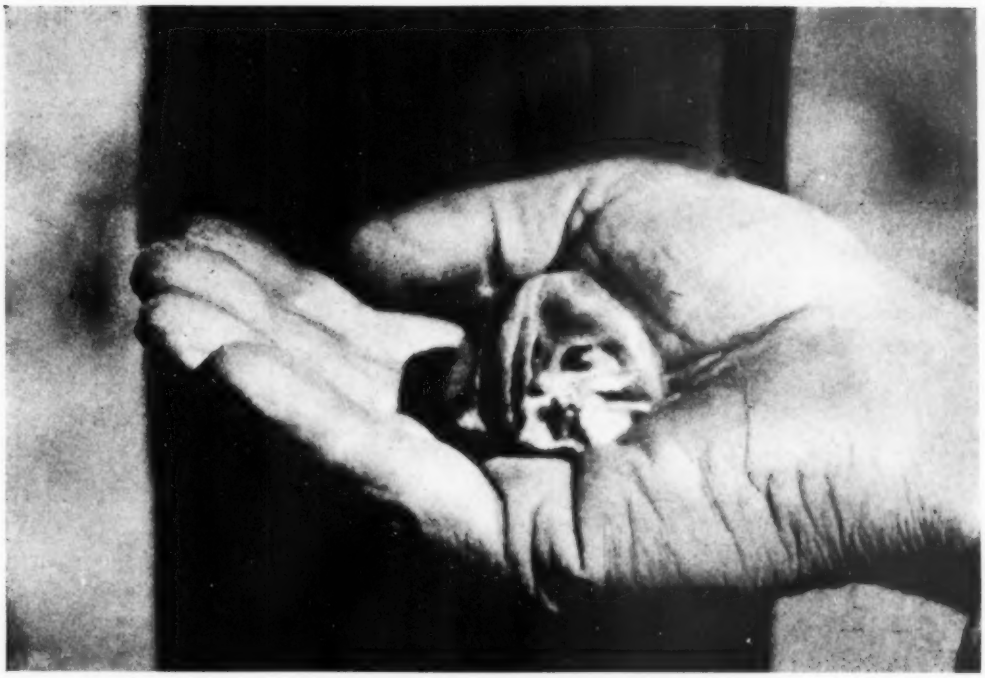
Usually the natives secured the phalangers by shooting them with poisoned darts from their long bamboo blowpipes, or else by snaring the simple-minded creatures with a rattan noose, or with a still stronger noose made from the root of the sugar palm (*Arenga saccharifera*) set on the branches of trees frequented by the animals.

Several years after my experiences with phalangers in Celebes I was collecting zoölogical material in Australia, the homeland of a wonderful assortment of pouched mammals. The pygmy flying phalanger (*Acrobates pygmæus*) was one of the chief desiderata and was very difficult to secure. I was therefore delighted to get advice from Mr. Harry Burrell, a famous Australian naturalist, as to the best manner of hunting it. According to him the equipment required was a "half-axe" (an axeman) and a pair of binoculars. A search must then be made for trees with holes suitable for nesting sites for the mouselike creatures. If the binocular reveals tiny claw marks and scratches about the entrance to the hole, simply cut down the tree and take out the phalanger.

It was winter in the highlands of northern New South Wales when we wandered about through the beautiful open forest composed mostly of trees known locally as "stringy barks" (*Eucalyptus obliqua*) and "white gums" (*Eucalyptus hæmastoma*). Many of these were great tall trees and all had rather sparse foliage on their peculiarly gnarled and twisted branches. Scattered among them were a few smaller trees, the most remarkable being the peculiar "bottle brush" tree (*Banksia*). The ground beneath them was

THE PYGMY FLYING PHALANGER

This phalanger (*Acrobates pygmæus*) is also called the "feather tail," because its tail has short hair on the upper and lower surfaces and long hair on the sides



A DIMINUTIVE MOTHER

This tiny flying phalanger (the same specimen as shown on the opposite page) the size of a mouse, was found hibernating. In its pouch were four young ones, each the size of a small bean

covered with a very fine-leafed grass, now pale buff and dry and strewn with strips of eucalyptus bark and branches.

High on the side of the bole of a towering eucalypt I saw a "spout" where a branch, years before, had broken off. Decay had followed back the course of the branch in its growth and burrowed deep into the side of the tree. The growing wood about the entrance to this cavity now formed a heavy protruding fold that in time would close the wound. The opening, however, still appeared to be three or four inches in diameter and there were undoubtedly little scratches on the smooth light-colored bark about the entrance.

It seemed a shame to cut such a fine tree but here it really made no difference, for all the trees at this particular place were doomed to be either cut or ringbarked so that better grass might grow beneath for the pasturage of cattle.

As soon as it was decided that the "spout" looked promising, my "half-axe" companion set to work to fell the tree, which was about three feet in diameter. When I asked him which way it would fall, he replied that he could fell it in any direction I wished—and he did.

In an hour or less the tree was down. The hole in the "spout" was not as big as it had looked, not even large enough to permit my hand to enter. Besides, the entrance was covered with ice in which were bits of leaves and bark. There was evidently a nest inside. It was therefore necessary to chop through the side of the "spout," but when a small hole was made, the presence of the nest became a certainty and the "spout" had to be chopped off completely, an awkward job for any but a skilled axe-man. Then the nest was opened. On the outside were the long lanceolate leaves of the eucalypt and inside was its finely shredded bark,

Courtesy of N. Y. Zoological Society

AUSTRALIAN OPOSSUM

The common vulpine phalanger (*Trichosurus vulpecula*) gets its name from its foxlike visage. It is the Australian opossum of the fur trade and the commonest of the Australian fur bearers

Courtesy of N. Y. Zoological Society

THE MEDIUM-SIZED FLYING PHALANGER

This creature (*Petaurus*) is commonly called a squirrel in Australia, for it closely parallels the American flying squirrel in size, color, and habits, though in fundamental characters it is not related to this rodent but belongs in the same group with the kangaroos

A RING-TAILED PHALANGER

The habitat of this creature (*Pseudochirus lemuroides*) is the limited area of tropical rain forest along the coast of North Queensland. Another species ranges over the greater part of the forested area of the continent

Courtesy of N. Y. Zoological Society

A CAPTIVE AUSTRALIAN OPOSSUM

This animal is one of the most generalized phalangers and is often found wandering on the ground. It varies in color from pale silvery gray to a deep reddish-brown

forming a dry covering for a beautiful little animal not larger than a mouse, with the form and almost the coloring of our American flying squirrel.

At first we thought it was dead but we soon learned that it was only hibernating. After being taken back to camp and kept in a warm place for an hour or more, it roused. We then examined it carefully and found it to be a female with four minute young ones in its pouch, each the size of a small bean, naked, blind, and all hibernating, too.

Besides the phalangers already mentioned and many others related to them, there live in the same locality many more pouched mammals, foremost among them and largest, the kangaroo.

Kangaroos are hunted by stalking them on foot after the manner practiced in hunting deer. Many professional kangaroo hunters hunt on horseback and shoot from the saddle, or slip to the ground to shoot. The best sport, however, is to chase the kangaroo on horseback with a couple of "kangaroo dogs" or greyhounds. I found this great sport but by no means a sure way to secure the kangaroo.

When pursued through the tall grass, the great gray kangaroo bounds away with amazing speed and ease. At a little distance the greyhounds cannot be seen, only the kangaroo bobbing up and down and dodging from side to side. Apparently the kangaroo hops high enough to see the logs and gullies in time to avoid or jump them, but several times I have seen dogs stopped or hurt by running into a hidden log. This reminds me of the following passages taken from the account by Captain James Cook of his voyage of exploration to the east coast of Australia. He writes:

Courtesy of N. Y. Zoological Society

RIDING IN ITS MOTHER'S POUCH

Young wallabies and kangaroos lean out of their mothers' pouches and learn to feed on vegetation before being finally turned out into the cold world

Botany Bay, May 1, 1770. . . . We had a transient and imperfect view of a quadruped about as big as a rabbit [a rat kangaroo]. Mr. Bank's greyhound, which was with us, got sight of it and would probably have caught it, but the moment he set off he lamed himself against a stump which lay concealed in the long grass.

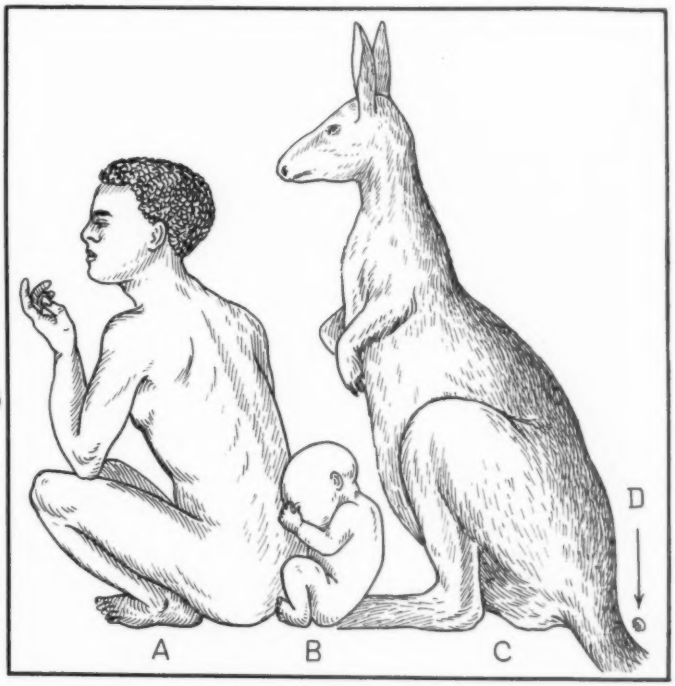
And further, when the kangaroo was first seen, near the mouth of the Endeavour River:

June 24, 1770, . . . I saw myself one of the animals which had been so often described: it was of a light mouse colour, and in size and shape very much resembling a greyhound; it had a long tail also, which it carried like a greyhound; and I should have taken it for a wild dog, if instead of running, it had not leapt like a hare or deer; its legs were said to be very slender, and the print of its foot like that of a goat; but where I saw it the grass was so high that the legs were concealed, and the ground was too hard to receive the track.

July 8, 1770, . . . they saw four animals of the same kind, two of which Mr. Bank's greyhound fairly chaced, but they threw him out at a great distance, by leaping over the long grass, which prevented his running: this animal was observed not to run upon four legs, but to bound or hop forward upon two, like the *Jerbua*, or *Jaculus*.

These extracts are from the original description of the kangaroo. It is interesting to note that this description led European naturalists of the time to consider the kangaroo a sort of giant pouched rodent related to jumping mice and jerboas on the one hand, and on the other to the American opossum, which was the first marsupial ever known to Europeans.

One of the most interesting things about marsupials is their condition at birth and their subsequent development.

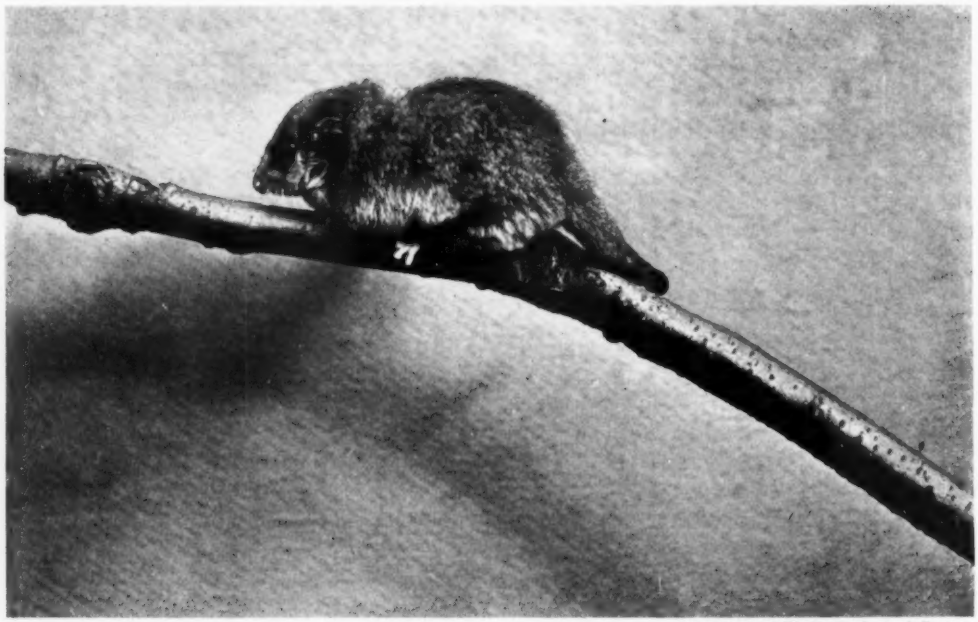


NATURE'S CONTRASTS

Figures drawn to scale to show the proportional differences in head and body length between the adult and young at birth, of man and the kangaroo. A—adult man; B–new born child; C—adult kangaroo; D—new-born kangaroo

When a kangaroo is born, its crown-rump length is less than one inch. In this immature condition it emerges from the cloaca of its mother and immediately starts crawling upward through the hair to the pouch. At this stage the forelimbs of the young kangaroo are actually larger than the hind limbs and are provided with tiny claws. With overhand strokes the young one makes its way unassisted into the pouch, where it locates one of the four teats.[1] The teat is more easily received into the mouth of the young one, for as part of the maternal preparation for this occasion, it has become pointed and turgid. Within a short time after the young animal has seized the teat, this swells out at the tip

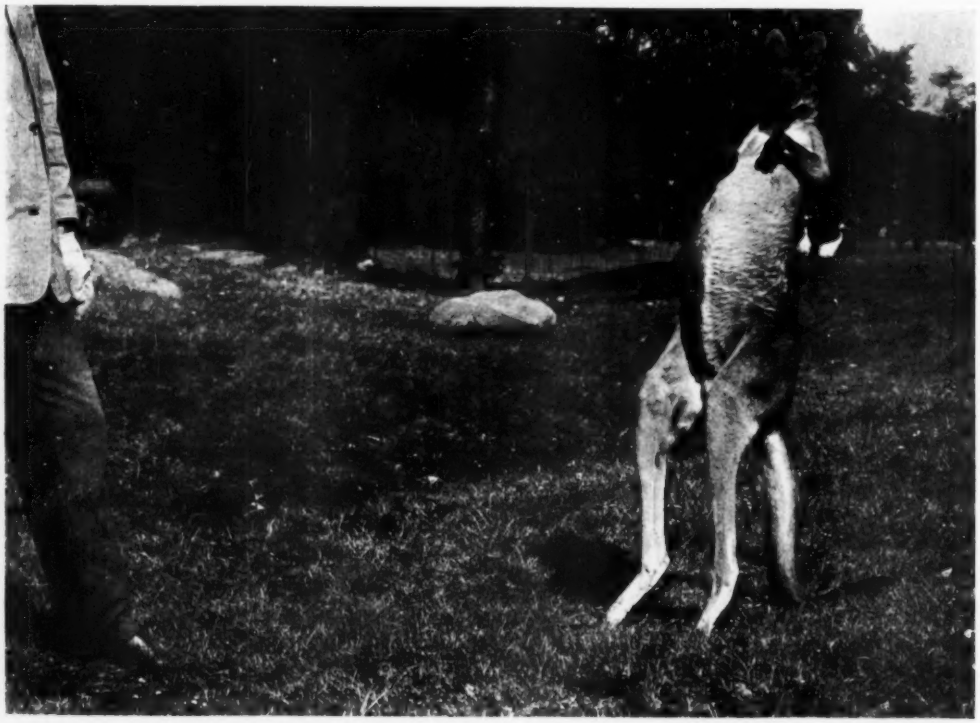
[1]It has been claimed that the mother kangaroo takes the young at birth and places it on the teat in the pouch. The clumsy paws of a kangaroo are suitable for digging out grass roots, for awkwardly holding grass, and for scratching, but certainly not fitted for picking up or handling the delicate newborn young.



Courtesy of N. Y. Zoological Society

A LITTLE NIGHT PROWLER

The doormouse phalanger (*Dromicia*), is a seclusive mouselike creature whose prehensile tail is doutless a safety factor during nightly rambles in the treetops, in search of herbivorous and insectivorous food



Courtesy of N. Y. Zoological Society

ON THE DEFENSIVE

In order to strike with the hind foot, or to get a better view of the surrounding country, kangaroos stand on their toes and use their tails as props

Courtesy of N. Y. Zoological Society

A RELATIVE OF THE KANGAROO

The bettong (*Bettongia*) is one of the rat kangaroos which might be mistaken for a phalanger if it were not for his greatly elongated hind feet

FAVORED BY FORTUNE

The most abundant of the Australian marsupials is the large flying phalanger (*Petauroides volans*), for it has a worthless skin and thus escapes the fur hunter

to fill the mouth cavity, so that the young is practically buttoned to its parent, with its mouth representing the buttonhole.

In the field the young are often found by hunters and trappers at this stage in the pouch of the slain female, and of course when the tiny creature is pulled from the teat, its lips are ruptured and they bleed. This undoubtedly gave rise to the widely spread belief among Australian hunters that the marsupial young originate and grow on the teat of the mother.

In the colder parts of Australia the young kangaroos are born at the beginning of the Australian winter (about April). They remain in the pouch until spring (October), then run with the mother during the summer and frequently longer.

The Australian marsupials are hunted and trapped almost entirely for their skins, though the flesh of all the kangaroos is very good to eat. Naturally they are taken mostly during the Australian winter, when the fur is at its best. This unfortunately necessitates killing a pouch young with every adult female, since every normal adult female has a helpless young one in its pouch at that time.

Some Australian marsupials have already become extinct and the ranks of those that are still obtainable are yearly being thinned by trappers for the fur trade. As the ranks of the best grade of fur-bearers are decimated, related animals somewhat less desirable are also exploited. Thus for a few years the annual decrease in the number of skins is not alarming; however, the inevitable result is not very distant, provided the destruction is allowed to continue.

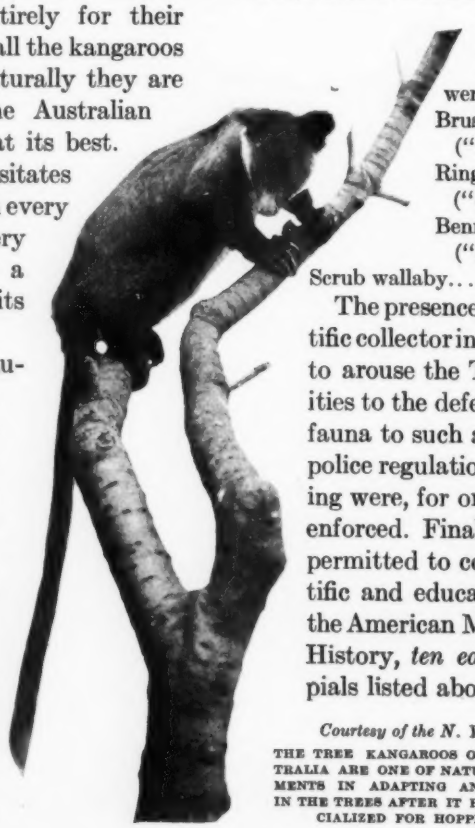
Several years ago when Prof. William K. Gregory and I were in Australia in the interests of the American Museum of Natural History, he expressed through the Australian papers the great zoölogic interest of the Australian fauna and the hope that it would be adequately protected for posterity. Many of our Australian scientific friends were already deeply interested in the protection of their fauna and have encouraged the enactment of protective measures.

The greatest number of marsupial skins at present undoubtedly come from Queensland, but the following figures from the little island state of Tasmania are characteristic. In their book *The Vertebrate Animals of Tasmania*, published in 1924, Messrs. Lord and Scott state that

"... during the last open season the following furred animals were trapped:

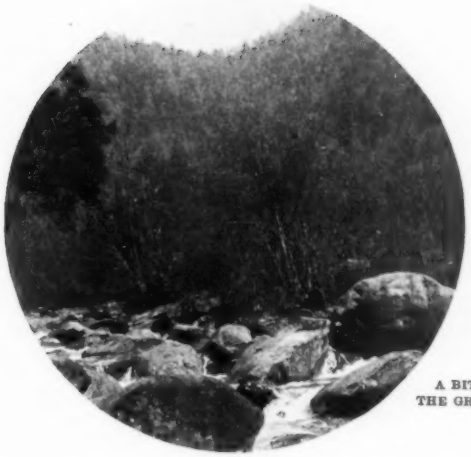
Brush phalangers ("opossums").. 105,968
Ringtail phalangers ("opossums")...587,179
Bennett's wallaby ("kangaroo").. 146,236
Scrub wallaby.....201,365

The presence of a foreign scientific collector in their midst seemed to arouse the Tasmanian authorities to the defense of their native fauna to such an extend that the police regulations against collecting were, for once at least, rigidly enforced. Finally, however, I was permitted to collect for the scientific and educational purposes of the American Museum of Natural History, *ten each* of the marsupials listed above.



Courtesy of the N. Y. Zoological Society

THE TREE KANGAROOS OF NEW GUINEA AND AUSTRALIA ARE ONE OF NATURE'S SUCCESSFUL EXPERIMENTS IN ADAPTING AN ANIMAL AGAIN TO LIFE IN THE TREES AFTER IT HAD BECOME HIGHLY SPECIALIZED FOR HOPPING ON THE GROUND



A BIT OF
THE GREAT SMOKIES

SALAMANDERS OF THE GREAT SMOKIES

Grubbing for Spring Lizards in the Brooks and Mountains of Northern Tennessee

By WILLIAM G. HASSLER
Department of Reptiles and Amphibians, American Museum

SALAMANDERS are "spring lizards" to our southern mountaineers, who use them as bait for fishing, but these people certainly would never think of going hundreds of miles to collect a trunkfull. I am sure that to some of the mountain folk living in one small community of the Great Smokies along the Tennessee - North Carolina border, I seemed "quare," (queer).

The small, cold-blooded animals called salamanders form a large branch of the class Amphibia, and are closely allied to the frogs. Though they have a tail and four small legs, their skin is unprotected and often slimy, a character that separates them from the true lizards, which have dry, scaly skins. Cold mountain brooks splashing along their stony beds, spring trickles seeping over mossy rocks and under old logs, boggy places and slow-moving streams, all have their peculiar forms of salamanders. Some of these are wholly aquatic, others only partially so. Still others are terrestrial and are found living under stones and rotting logs.

A large series of living salamanders were desired for experimental work in the laboratories of the American Museum. It was also expedient to secure information on certain species in the field, particularly the habits and probable relationship of a reddish-cheeked, semi-aquatic salamander. This color phase has been found in the Great Smoky Mountains, and it therefore became my good fortune to spend a few days collecting in these, the most beautiful and interesting of our southern mountains.

Wiley Oakley, of Gatlinburg, Tennessee, was my helper and guide for the first two days. Self-styled "Roaming Man of the Mountains," he not only knew of all the likely streams and springs, but could also tell many stories of the mountaineers. Sometimes, while working up a stream he would remark,

"Perhaps they're makin' likker up thar in the holler."

A piece of stove or other rusty iron in the stream would bear evidence that moonshine had been secretly made near by.

RETURNING HOME WITH THE DAY'S CATCH

Woodrow and Orville Oakley helped collect on several days and this particular afternoon the party returned with about 140 spring lizards. Orville also had some snakes, but these he preferred to carry at arm's length

GAUDY IN BRIGHT YELLOW AND BLACK

Six long-tailed salamanders (*Eurycea longicauda*) were the most brilliant of the captures. Their slender yellow and black bodies were in sharp contrast to the dark brown mud under the stones where they hid

WHERE LIZARDS MAKE THEMSELVES AT HOME

Fence lizards and skinks were often seen basking in the sun on old buildings, fences, and stone piles, so the expedition stopped to looked for them on this unoccupied mountain house near "Pant'er Creek"

A "GROUND PUPPY" IS DISCOVERED

Popular names of reptiles and amphibians differ with each locality. "Red Puppy" was another name for this salamander which the party sought in every stony stream, and which, as though to mock them, would as often be found in dry situations

Snow covering the tops of LeConte and showing white between the balsams made collecting useless in the higher reaches the first day after I arrived. So Wiley and I investigated the streams in the valleys near by. We each carried a knapsack containing several nests of cans, our lunch, and a cloth bag or two for reptiles, also a mattock with which to overturn stones and to rip off bark and moss. The streams were swollen from recent rains, but some specimens were found in the headwaters and in springs and their overflows. Large, dark brown, mottled salamanders were the first found. They are known as *Desmognathus phoca*, and live under stones and logs in the water. A smaller species (*Desmognathus fuscus carolinensis*), is usually found in slightly drier situations. These were much more common along small trickles of water.

Photograph by Edna L. Simms

SET FOR BIGGER GAME THAN SALAMANDERS

An ardent lover of his native mountains, Wiley Oakley always had some story in store about the Smokies, their forests, wild life, and people

A swath of loose and overturned stones marked our wake. Along the banks of a brook it wound, ever upward among the rhododendron thickets, and the cry "Here's another, and it's one of those big reddish ones," would proclaim that Wiley had caught a purple salamander. Hastily the animal would be dropped into a collecting can, and the search would go on under the stones for more.

From Gatlinburg a stream led us to some property of Wiley's, where, on a clearing, a little log barn stood surrounded by old stumps. Here on the gray, rough building, two kinds of true lizards basked in the sun. The fence lizards were almost exactly the color of the logs, and discernable only with difficulty. They would dart squirrel-like to the other side of the log when we approached. By working from opposite directions we were able to capture several. The other kind were skinks, or "scorpions" as they are called all over the South. Wiley took my word that they were not "pizen," and we tried hard to catch some, but they were much more wary and fast than the fence lizards.

One day just before lunch I caught a three-foot house snake. It was a beautiful reptile, much like our eastern milk snake. Its habits and food are similar, and it is often found near houses, where it preys on mice. Wiley, however, did not appreciate it, and insisted that I carry the bag it was in.

Under some flat stones in the grass-grown outlet of a well-like spring not far from Panther Creek, we found six bright yellow and black salamanders. As we had been finding only drab-colored *Desmognathus*, those attractive ones were a most welcome change, and, as it proved later, were the only ones collected on the whole trip.

A terribly rough auto ride over a new road that was being constructed through the "sugarlands" and over Indian Gap brought us to a number of little streams flowing into Alum Cave Creek below. We were more than 3500 feet

above sea level, and high enough to find the red-cheeked "spring lizards" that I particularly wanted to study and collect.

After searching vainly for perhaps an hour, we were nearly discouraged, when both of us suddenly discovered specimens at almost the same time. All the trickles from then on yielded some, and collecting for the day ended under a beautiful falls tumbling off the cliffs of Fort Harry Mountain, a spur of Le Conte.

One afternoon, while investigating the streams around Elkmont, we went to see the gold mine of "Uncle Levi Trenham," who is often called the "Prophet of the Great Smokies." Mrs. Edna L. Simms, who took me over in her auto, and Will Ramsay, another guide at Gatlinburg, showed me the peculiar stone that, according to an Indian legend, points to gold. This huge stone has carved deep on its face the imprint of a man's hand, a bear's foot, and two eyes. It was lost for many years, then rediscovered on "Uncle Levi's" farm. So far no great amount of gold has been found, though small quantities have been dug out, but Uncle Levi hopes that some day he will find the real deposit.

Two of Wiley Oakley's boys helped me on several trips. They enjoyed collecting and worked hard at it. May 12 was devoted to a trip up Le Conte. Mill Creek flows down the side of this mountain and here I hoped to find a goodly number of salamanders. I was disappointed in this, however, probably because the snow had not yet melted completely, and the water was icy cold. Under stones along the trail a number of black salamanders with red cheeks were found. These were a terrestrial form, and different from the ones we had previously caught.

The trail up Le Conte is difficult but most interesting. Large outcroppings of rock forced us to climb continuously along the lower portions of it. About half way up, Mill Creek takes a beautiful plunge of some sixty or eighty feet off a ledge. Orville, the younger of the two boys, was with me that day, and told me stories of the mountain wildcats that cried at night near the house where he used to live, of "bars" (bears) and other wild life. At the top we had a snowball fight just to prove that the climb had not tired us. From the ledge where we ate our lunch, above a sheer drop of hundreds of feet, we could see for miles over the thick green mountain-tops that stretched below us. A young eagle cried every now and then from the wilderness below, and we could hear faintly the tinkling of Little Pigeon River, hidden in the valley.

The following day was my last in Gatlinburg, and 570 living salamanders and a number of snakes had to be repacked for shipment to New York. We put fresh moss around the salamanders, placed them in perforated containers, and then made them all snug in a trunk. The trip to New York seemed to agree with them, for they were all alive and well when opened at the American Museum.

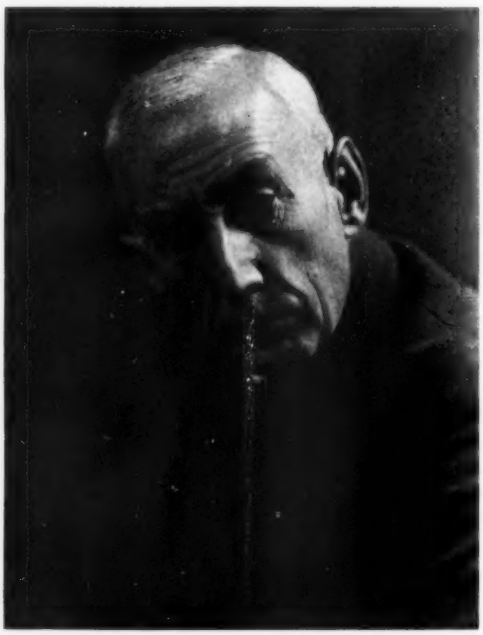
Photograph by Edna L. Simms

THE PROPHET OF THE GREAT SMOKIES

ROALD AMUNDSEN

By LINCOLN ELLSWORTH

IT seems the irony of fate that Roald Amundsen's life work should have ended somewhere near where it began—in the Norwegian Sea, off the coast of his native land where, as a lad of fifteen he started out before the mast on a career of great adventure. But the finding of bits of wreckage of his plane in which he with five companions sailed away in succor of former comrades lost somewhere in the Polar wastes, leaves little hope that this supreme adventurer who so often tempted fate in quest of the unknown, and who always came back, has at last paid the supreme sacrifice and journeyed into the unknown—that Great Unknown—from which no man ever returns.



ROALD AMUNDSEN
The last photograph of the great Polar explorer taken just before he started on the historic flight in the "Norge" in 1926

But the end, no doubt, was as he himself would have wished it, for Amundsen often told me that he wanted to die in action. He could bear the thought of no other way.

Life's friendships are transient things. Silently, like shadows in the night, they come—and are gone away. With the loss of this devoted friend—for Roald Amundsen and I had much in common together—goes the last of my boyhood heroes. (Roosevelt and Peary were the others.)

Beyond the last frontier—beyond even the outermost rim of discovery, toward that huge tract in the Polar Sea marked "unexplored" lay my dreams! But how was I to get to that land of far horizons? The dreams of youth are long, long dreams, and I am certain that they never could have found realization had not chance—or was it fate—brought us together? This was in October, 1924, and the two years of our close intimacy never dulled—it only served to enhance—the hero worship in which I held him. Such was the magic spell that this man's personality wove about me. Just why or how would be difficult to explain.

Although years of battling in regions of eternal ice had bred in Amundsen something that carried outward, visible signs—that indelible stamp of the Arctic—underneath the man of cold reserve lingered much of the spirit and enthusiasm of a boy. "Do you know," he said to me, on his arrival in America the last time, "I have adopted many of your ways. I have learned to smoke my pipe in bed of evenings and have written to Montreal for fifty pounds of that French-Canadian tobacco you smoke, and I eat only two meals a day now. I

never have that tight feeling around the belt any more."

With the passing of this pictureque viking of an old school, whose strong weather-beaten face with its steadfast eye, hearty handclasp, ease of bearing, and innate modesty, captivated all those with whom he came in contact, goes a certain something that has to do with romance, with youth, with the dreams of life, for Amundsen's attainment of the South Pole closed the chapter of that romantic history of Polar exploration by men using ships and dogs as a means of transport. "Their place now," he says in his memoirs, "though forever glorious, is in the museum and the history books. Aircraft has supplanted the dog." Strangely enough Amundsen was himself one of the first to foresee the possibilities of, and to participate in, this new method of exploration. But it wasn't his game, he told me,—guessed he was too old to learn. Certain it is that, with the passing of the dog and sledge, exploration has been robbed of much of its early romance and glamour, born of the age when, out of the sheer urge for bodily effort, men traveled forth to explore the yet untrodden.

Modern progress moves so swiftly that fact often transcends fancy. The dreams of one age become the realities of the next, and today, as we wing our way in comparative comfort, cutting the years to hours in our swift flight over the unknown, the stories of hardships and sufferings endured by those travelers of yesterday seem as remote as lessons taken from the Old Testament.

But in the ages to come, the navigation of the northwest passage, the attainment of both Poles and the first crossing of the Polar Sea by Roald Amundsen, will ever remain a monument to an heroic effort—a symbol of devotion to an idea: "To seek, to strive, to find and not to yield." Whatever its value to civilization, the effort was not in vain. Of such stuff are heroes made, the world needs them. They are the salt of youth, and out of the salt of youth comes the iron that makes for mature manhood.

Amundsen would have been fifty-six years old last July 16 had he lived, for he was born in 1872. He had attained all the major Geographic prizes left to the Twentieth Century, but he was not a happy man. No idealist ever is. "Whatever remains to man unknown in this world of ours," he says in his memoirs in speaking of the "good" of Polar exploration, "is by so much a burden on the spirits of all men. It remains a something that man has not yet conquered—a continuing evidence of his weakness, an unmet challenge of his mastery over nature. By the same token, every mystery made plain, every unknown land explored, exalts the spirit of the whole human race—strengthens its courage and exalts its spirit permanently. The trail breaker is an indispensable ally of the spiritual values which advance and sustain civilization." And so, accustomed all his life to the thrill of great adventure, he suddenly found himself, at the age of fifty-four with nothing left to do, for he had lived to see the old method of "going exploring" become obsolete, and the new way wasn't his.

His whole life had been one long, uphill struggle in the face of terrific odds—mental as well as physical. Lack of funds had forced him to rent a bakeshop and with his own hands prepare all the pemmican used on his South Pole expedition. On one of his Arctic voyages, he told me, he had to "turn to" as cook for his men in order to keep up the morale. But where there is a will there is a way, and Amundsen always found the way with that courage born of the right, which, through life, held him ever true to his ideals.

Of such stuff was the man Roald

Amundsen. He had acquired a philosophy of life that taught him to accept, with equal equanimity, whatever the day brought forth. I cannot see him other than the great leader he was,—a man inspired by the highest ideals and responsive to all the finer and nobler things of life, beloved and admired by all those with whom he came in contact. His supreme effort, while it cannot be measured in terms of human lives saved, will go down through the ages as one of the finest examples of self-sacrifice ever made. He gave of his best, and God grant that in so doing he may receive of the best. Could I, who have been made better by his influence and example, give adequate expression to the tribute due him, it would be "as a fadeless garland in which the laurel of victory is entwined with the roses of love."

So "SKOAL"! Roald Amundsen.

"The winter's cold, that lately froze our blood,
Now were it so extreme might do this good,
As make these tears bright pearls, which I would lay
Tombed safely with you till doom's fatal day;
That in thy solitary place, where none
May ever come to breathe a sigh or groan,
Some remnant might be extant of the true
And faithful love I shall ever bear for you."

BASHFORD DEAN

By HENRY FAIRFIELD OSBORN
President, American Museum of Natural History

ON December 7 word was received at the American Museum of Natural History of the death on December 6 of Honorary Curator Bashford Dean, who has been connected with the Museum in the department of fishes since 1897, receiving his first appointment in the Museum not long after receiving his degree of Doctor of Philosophy at Columbia University.

Dean was the most brilliant and promising student of John S. Newberry, a distinguished professor of geology and palæontology in the strong School of Mines faculty of that day, and Dean fell heir to Newberry's remarkable collection of extinct Devonian fishes, which is now in the American Museum. He soon became master of this collection and began a very remarkable series of restorations of the Devonian fishes of Scotland and North America. This established his fame as an ichthyologist.

In the American Museum Dean rose year by year until in July, 1909, he achieved the rank of curator of ichthyology and herpetology. After many years of delay and disappointment his labors were crowned by the construction of the hall of fishes on the first floor of the new Asiatic wing of the Museum. With Mrs. Dean, he was expected as the guest of honor at the opening of this hall on Wednesday, December 5, for which occasion thousands of invitations were sent to all the members of the Museum. On the morning of the opening of the hall, Professor Osborn received a beautiful letter from Doctor Dean expressing his deep regret that he could not be present, for about a fortnight before he had left for the Battle Creek Sanitarium. Not one of his colleagues in the Museum was prepared for the sudden announcement of his death, which was due to a serious operation.

His career in the Metropolitan Museum of Art was no less distinguished and influential. Because of his life-long interest in armor and the armored fishes of the Devonian period, his native sense of form and of beauty had developed rapidly and is superbly expressed in the great armor

hall of the Metropolitan Museum. He rose to the first rank as a leading authority on armor not only in America but in Europe, where his name was a household word among connoisseurs. He frequented museums and private collections in Europe and was absolutely familiar with the very last of the *rarissima* in the field of armor. With his consummate knowledge, taste, and authority, he combined a sense of evolution of design and of mechanism so that it may be said that in our great museum he laid the foundations of the evolution of fishes, and in the great sister museum across the Park the cognate evolution of armor.

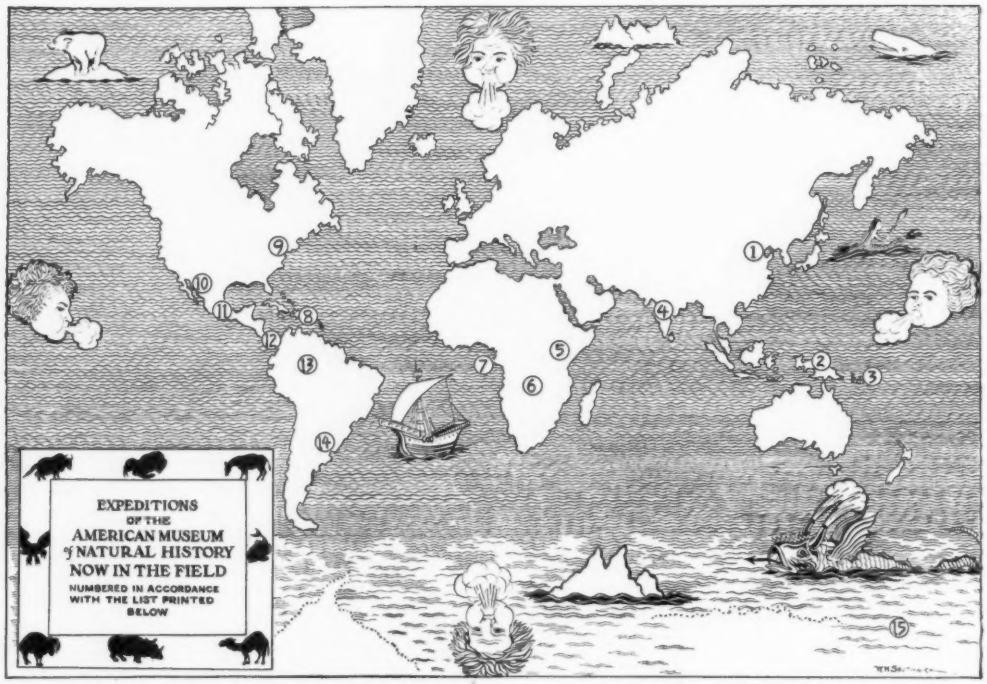
BASHFORD DEAN, 1867-1928
In the uniform of a major (of ordnance) during the Great War

His third activity, which occupied the early years of his professional life, was first as assistant, and then as full professor of vertebrate zoology at Columbia University, beginning in the year 1904. Here he became the master of several now famous ichthyologists and comparative anatomists, including especially Professor William K. Greogry, who has continued Professor Dean's researches in the series of publications covering the whole field of recent and extinct fishes.

Throughout his entire career he had a very strong phylogenetic or evolutionary sense, both as to the beginnings of ichthyology and as to the beginnings of armor. This expressed itself in one of his most fundamental undertakings, namely, a catalogue of all details relating to fishes from the earliest classical times. Aided by Dr. E. W. Gudger, this culminated in three monumental volumes, known as the *Bibliography of Fishes*, for which Professor Dean was awarded the Daniel Giraud Elliot Medal for 1923 by the National Academy of Sciences.

The fourth feature of his life was his career as an explorer in ichthyology, which carried him to the seas of the Far East as well as to the rivers of America, resulting in a superb collection illustrating the embryonic development of fishes to be published in a memorial volume by the American Museum of Natural History.

President Osborn, Professor Gregory, and Dr. E. W. Gudger, lifelong associates of Curator Dean in his great works in ichthyology, were shocked and inexpressibly grieved by the news of Doctor Dean's unexpected death. They had been rejoicing with him in his prospect of retirement from his very active life after a service of thirty-eight years in the two great institutions as curator and collector. He had been relieved by both institutions of all administrative duties, and intended to devote his remaining years in his beautiful home at Riverdale-on-the-Hudson to the completion of several volumes on ichthyology and armor, summing up his lifelong researches and describing some of the most remarkable and beautiful of the types which he had been able to collect for the two institutions. To no other man has it been granted to leave such monuments of an intelligent, energetic, and untiring spirit as Doctor Dean leaves in two of the great museums of the modern world, the Metropolitan and the American.



1. Central Asiatic; 2. Beck, New Guinea, for birds; 3. Whitney South Sea, Solomon Islands for birds; 4. Vernay-Faunthorpe for Asiatic mammals; 5. Straus Abyssinian for birds; Sanford-Patterson-Legendre Abyssinian for mammals; 6. Tanganyika for birds and mammals; 7. Sao Thomé for birds (Thorne-Correia); 8. Klingel, Haiti, for birds; 9. Chester A. Reeds, Lake Passaic varves; 10. Sante Fé for fossils (Frick-Rak); 11. Vaillant, Mexico, for archæological finds; 12. Benson, East Panama for birds; Chapman, Barro Colorado for birds: Curran, Panama for insects; Blick, Honduras for fossils; 13. Tyler Duida, Venezuela, for birds and mammals; 14. Southeastern Brazilian (Naumburg-Kaempfer); 15. Byrd, Antarctic.

IN THE FIELD OF NATURAL HISTORY

Expeditions — Scientific Research — Conservation
Books — Meetings of Societies

EDITED BY A. KATHERINE BERGER

EXPEDITIONS

CENTRAL ASIATIC EXPEDITION.—Walter Granger and Albert Thomson are spending the winter months at the expedition's headquarters in Peking, busily engaged in preparatory work on the specimens collected during last summer, while J. MacKenzie Young is overhauling motors and equipment for next season's trip. Doctor Andrews will tell of some of the unusual hardships and difficulties of the season of 1928 in the March–April issue of NATURAL HISTORY.

THE CARLISLE-CLARK EXPEDITION has been brought to a successful conclusion, and all the material collected, including films and photographs, are now safe in the Museum.

Mr. and Mrs. G. Lister Carlisle, Jr., who very generously financed this expedition on behalf of

African Hall, left New York in April Mr. Raddatz, of the department of preparation, followed shortly after, to make preliminary arrangements. Mr. William R. Leigh, the artist selected to make studies in the field for the painted backgrounds, left in May, and Mr. James L. Clark, departed soon after. All the members met in Nairobi, Kenya Colony, about the middle of June, when final arrangements were made, and in a short time they were headed south in Tanganyika Territory, under the guidance of Mr. Alfred J. Klein, the professional hunter.

Two months were spent in virgin territory where Mr. Clark secured a very fine group of lions. As this country had not been hunted before, there were exceptional opportunities for the selection of fine specimens. Lions were found in the open in daylight, and thus could be care-

fully selected for types and condition. Seven specimens were collected, including a very large fine male. Mr. Klein stated that this was one of the five largest specimens he had ever recorded out of the five or six hundred he had seen shot.

Accessories for the groups, including trees, bushes, soil and rocks were also collected, and careful color notes of the leaves and flowers were taken to insure the finest results in design and detail.

Mr. Clark made a complete miniature scale model of the lion group in the field, which in itself established all the actual and natural records to insure final success. Mr. Carlisle, leader of the expedition, concentrated on wild life motion picture photographs and secured 8000 feet of really remarkable motion pictures of approximately thirteen varieties of big game, including the first pictures of a leopard ever taken and some exceptionally fine ones of lion. These, with Mr. Clark's close-up motion picture of two lions on a kill, are perhaps second to none. Hundreds of still photographs of the country, the people, and details for the group were also secured.

After the lion group had been successfully completed, the expedition moved to another section of Tanganyika, some eighteen miles south of Moshi, where they secured material and background studies for the lesser kudu group. A few odd specimens wanting for the African Hall collections, were taken as opportunity presented. Mr. Clark plans to begin the modeling of the lion group within a very short time, so that it may not be long before the public will see this important acquisition. The motion pictures are now being edited and it is hoped they will be ready for a showing to Museum members within a few weeks.

THE SANFORD-PATTERSON-LEGENDRE ABYSSINIAN EXPEDITION left New York on December 1, for Abyssinia, via Havre and Marseilles. This expedition has for its goal the collecting of a group of nyala, or mountain bushbuck, which will be mounted in the new Akeley Hall of African Mammals. The expenses of the party in the field are generously being met by Miss Gertrude Sanford, Mrs. Grace Patterson, and the Messrs. Sidney and Morris Legendre. Mr. John Sanford, father of Miss Sanford, has shown his great interest in the American Museum by offering to defray the costs of building the group and mounting the animals.

At the time of departure Mrs. Patterson was detained by poor health but hoped to join the party later. Mr. Gordon MacCreagh, who had recently returned from a lengthy sojourn in Abyssinia, was in charge of the expedition, and the Museum sent as its representative Mr. T. D. Carter of the department of mammals. In addition to the specimens of nyala, the party plans to make as extensive a collection of study specimens as is possible, and to take still and motion pictures. Abyssinia is a region practically unrepresented in the collections of this Museum, and this is an unusual opportunity which the generosity of the Museum's friends has made possible.

TYLER-DUIDA EXPEDITION.—Letters from the Tyler-Duida Expedition have notified the Museum that Mt. Duida has at last been conquered. On October 24 Tyler and Tate managed to reach the summit after a hard struggle. For weeks prior to that time they had been engaged in a systematic campaign collecting at base camps near the foot of the high country, cutting trails, and otherwise preparing for a deeper penetration into this unexplored area. One of the difficulties in the way of the expedition is the fact that this region has never been mapped and the method of attack had to be very largely one of trial and error. The dense tropical forest, which prevented a comprehensive survey of the terrain, and heavy fogs on the mountain also hampered progress.

The ascent of Mt. Duida proved to be steep and arduous. Mr. Tate wrote that a series of ladders would have to be constructed to pass an interval of 900 feet before the main work of the expedition could go on. Following this preliminary reconnaissance, the party will move equipment up to base camps on the top of the elevated plateau and should secure material of great value and interest.

The Tyler-Duida Expedition is a joint undertaking by the department of birds and the department of mammals. The expedition was made possible through the generosity of Mr. Sidney F. Tyler, Jr., who is financing the work as well as taking an active part in it personally. Mt. Duida is situated in a remote section of Venezuela and the region has never been adequately explored by any scientific party. The progress indicated by these letters from the field shows that already the American Museum expedition has accomplished much. The successful conclusion of this undertaking will constitute an outstanding achievement in South American exploration.

THE STRAUS ABYSSIAN EXPEDITION.—On January 19 the Straus Expedition sailed for a four months' trip to Africa to collect birds for the American Museum. The party, which includes Mrs. Oscar Straus, her grandson Mr. Edward Schafer, and Mr. and Mrs. Rudyard Boulton, plans to go up the Nile, through Uganda by automobile to Nairobi, and spend about two

weeks visiting the big game fields there. Mr. and Mrs. Boulton will then go on to Lake Nyasa to study and collect the birds of that region, and expect to return home by way of South Africa.

The expedition is made possible through the generosity of Mrs. Oscar Straus.

WILLIAM J. MORDEN, field associate in mammology, returned from Russia in December, after having visited Moscow, Leningrad, Tiflis, Batum, and Odessa. His purpose in visiting Russia was to obtain information and permits from Soviet scientists and officials in order that he might make his preparations for the Morden North Asiatic Expedition which will operate in Eastern Siberia beginning in 1929. He reports that he received every courtesy, and that the Soviet Government would be glad to assign a representative to accompany the expedition.

The plans for the Morden North Asiatic Expedition are now being prepared and will be announced later in NATURAL HISTORY.

TO HAITI FOR REPTILES.—Mr. Gilbert C. Klingel of Baltimore has organized an expedition to Haiti to study the life histories of reptiles of that island. He has sent many encouraging reports from the field, and has shipped 194 lizard eggs to be hatched out in the laboratories of experimental biology in the American Museum.

BARRO COLORADO ISLAND.—Dr. Frank M. Chapman is continuing his scientific studies of the birds on Barro Colorado Island.

ARTHUR VERNAY sailed recently for Bombay, where he hopes to obtain a pair of Indian lions for the Hall of Asiatic Mammals at the American Museum.

ASTRONOMY

DR. SETH B. NICHOLSON of the Mount Wilson Observatory in California gave a talk on January 2 before the Amateur Astronomers Association, in which he described how he has been measuring the heat from individual stars and planets by means of the thermo-couple. This instrument is so tiny that it is manufactured under a microscope, and when completed, weighs but a tenth of a milligram, or about one one-thousandth the weight of a drop of water.

At the JANUARY 16th MEETING, motion pictures of the planet Jupiter were shown to the members of the Association. These motion pictures, the first of their kind ever made, are the work of Prof. W. H. Wright of the Lick Observatory in California, and Dr. C. E. K. Mees, director of the Research Laboratory of the Eastman Kodak Co.

Many members of the Association took advantage of a wonderful lecture which Dr. Harlow Shapley gave on "The Galaxy of Galaxies" before the A. A. A. S.

ON FEBRUARY 6, Mr. Edward J. Gounod will speak on "Why Is Mars Red?"

ON FEBRUARY 20, Dr. John H. Pitman, professor of astronomy at Swarthmore College, will speak on "The Dimensions of the Stellar Universe."

BIRDS

NEW WOODCREEPER FROM PERU.—Among several new species of birds from Ecuador and Peru recently described by Dr. Frank M. Chapman (*American Museum Novitates* No. 332) is a remarkable woodcreeper from the Rio Ucayali to which he gives the name *Anachilus ucayalæ*. The bird is distinguished by the peculiar shape of the bill, in which the mandible or lower portion is strongly recurved or turned upward at the end. The occurrence of a similar type of bill in two other genera of woodcreepers and in a genus of antbirds, none of which is closely related to the new bird, is believed to indicate that this structure is due to parallelism of development. Whether it is related to the birds' manner of feeding is unknown.

THE NEW HALL OF FISHES AMERICAN MUSEUM

The opening on December 5 of the new Hall of Fishes at the American Museum marks the culmination of many years' work, begun by Dr. Bashford Dean, founder of the department of ichthyology, and continued by Dr. W. K. Gregory, its present curator. Addresses were given by President Osborn, Doctor Gregory, Doctor William Beebe, and Director Sherwood.

The lifelike groups and undersea scenes have been prepared by highly skilled artists and preparators, working under the direction of Doctor Gregory and of James L. Clark, assistant director of the Museum.

The darkened inner hall of undersea life contains a series of seven panels of deep-sea fishes modeled by Dwight Franklin, and represents a descending series of zones of fish life. The original materials and data for these groups were for the most part collected by the "Arcturus" expedition in the Pacific Ocean, in the neighborhood of the Galapagos Islands.

HISTORY OF THE EARTH

CHILDS FRICK TERTIARY-QUATERNARY EXPLORATIONS, 1928.—The search for additional evidence regarding the animal groups of the Late Tertiary-Quaternary, their differentiation, hori-

zons, and distribution, was carried on in six localities, including our widely separated New Mexican and Californian key stations.

The investigation of the difficult Miocene beds to the north of Barstow in the Mojave Desert, California, was continued for the eighth consecutive winter by Mr. Joseph Rak and assistants. The season's collections include particularly important material from the until recently believed non-fossil bearing strata, Joseph Rak Beds, which unconformably underlie the typical Barstow formation.

Work in the Hopi Indian Agency was resumed in the early spring by Mr. John C. Blick, assisted by Messrs. Charles Falkenbach and Joseph Rooney. The great Upper Pliocene pocket discovered there the past season was completely excavated by June first. It has yielded a grand total of forty-one large cases of skulls, jaws, and other remains of the huge extinct camel, *Megacamelus blicki* n.g. and n.sp., (facial fossa marked and p $\frac{2}{2}$ absent). Perfectly preserved skulls testify to a head in the flesh of over a yard in length, and limb elements to an occasional height at the withers in excess of eight and one-half feet. Partial reconstructions of this massive limbed beast and of a widely different and also newly discovered elongate-limbed form, *Altomeryx raki* n.g. and n.sp., from the Lower Pliocene of New Mexico have been temporarily installed in the Museum's camel alcove. This Arizona investigation was undertaken originally through the courtesy of the Department of Indian Affairs and the National Museum, and has been greatly facilitated by the Hopi Reservation's able superintendent, Mr. E. K. Miller. Mr. Blick, at the present writing, is in Central America investigating a reported occurrence of Pliocene mammals.

Researches were carried on in the Miocene, Pliocene, and Pleistocene to the north of Santa Fè, New Mexico, for the fifth full May to November season, the party as usual being under the capable direction of Mr. Rak. Our collections from this area are several times greater in size than collections from any other American Late Tertiary locality. Erosion annually uncovers material but that of the past season was secured only through hard and skillful work. The collections are rich in remains of horses, rhinoceroses, long symphysised mastodons, antelopes, and above all, of camel forms. The latter vary in size from a diminutive to a giant-giraffe-like species, in which the metatarsus(650 mm.) is four times the length of the former. A previously unrecognized uppermost horizon has yielded a widely different, heavy limbed camel suggestive of that of Arizona. The writer and Mrs. Frick spent three weeks of September with Mr. Rak in study of the fossil occurrences and of interesting problems of local stratigraphy. The great carnivore, *Amphicyon*, seems to have been as rare locally as *Hemicyon* and has for the first time been checked as present. Replicas of the skull and jaw of our single *Hemicyon* have been given to several European and American museums including that of Sante Fe. *Aleurodon* wolves are common in the upper beds. A unique block holding the beautifully preserved, practically complete, and gracefully grouped skeletons of three young Oreodonts (*Merychyus medius* race novomexicanus n. r.) has been recently placed on exhibit in the American Museum.

The Pleistocene exposures along the Niobrara River near Hay Springs, Nebraska, were visited during midusmmer by Messrs. Rak and Falkenbach, and subsequently a considerable amount of fragmentary material was obtained there by Mr. Falkenbach. The tapir has been added to the previously known fauna, and the Museum's collections of local camel remains more than quadrupled. On the basis of certain specimens with p $\frac{3}{3}$ typically present, *Camelus americanus* is transferred to a new genus *Procheni*a.

The exploration of beds of Devil's Gulch-Valentine Pliocene affinity, in the vicinity of Ainsworth, Nebraska, was continued for the second summer by Mr. M. F. Skinner, who has sent us additional specimens of rhinoceroses and long-chinned mastodons, dentitions of horses and a half dozen partial camel mandibles of the rare "*P. vera*" type.

Exposures in the neighborhood of Elephant Butte and Benson, Arizona, have for a second time yielded Mr. Rak, while en route to California, a small but useful collection of Late Tertiary and Pleistocene remains. Mr. Falkenbach will spend the coming months in further investigation of this southern Benson phase,where Dr. J. W. Gidley several winters past was so successful in obtaining *Stegomastodon* and *Glyptodon*. For the good reason that the handling, figuring, and preparation of material demand both time and skill, our little staff, Miss D. G. Tagert, Miss H. de Berard, Mr. Charles Hoffman, and Mr. Joseph Rooney, have been constantly occupied

These explorations, originally undertaken for the purpose of obtaining through adequate collections from definite horizons a more exact knowledge of the history of the horses, have continued (as noted above) to yield a surprising number of camel specimens, which both in number and variety exceed the horses. Eventually the camels should afford a most valuable guide and check in the interpretation of fossil

evidence as to conditions existing in the American Late-Tertiary-Quaternary — including continental changes and the coming and going of animal forms. On the completion of the preliminary descriptions of the new camel species and the reclassification of the group, it is planned to exhibit the more striking of these forms in a new and much enlarged alcove in the Hall of Tertiary Mammals, so that the entrance to this hall will be flanked on right and left respectively by instructive series of the extinct American forerunners of man's two most doughty helpmates—the camel and the horse.—CHILDS FRICK.

HONORS

DR. FRANK E. LUTZ, curator of insect life at the American Museum, has been made a member of the Committee on Experimental Animals and Plants recently appointed by the National Research Council. The functions of the committee are to make arrangements for central supplies of animals and plants of known value in experimental biology and to test hitherto unused species of promise.

MR. H. E. ANTHONY, curator of the department of mammalogy in this Museum, has been elected a fellow of the New York Zoological Society, a class of membership the qualifications for which rest upon scientific achievement.

CURATOR HERBERT P. WHITLOCK of the department of minerals and gems at the American Museum has recently been appointed honorary curator of minerals by the Trustees of the Wadsworth Atheneum at Hartford Connecticut

MEETINGS OF SOCIETIES

THE AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE.—Once every twelve years this Association comes to New York during the Christmas holidays to hold its annual meeting. The fifth New York meeting, and the eighty-fifth in its history, convened from December 27, 1928, to January 2, 1929.

The convention proved to be the largest that has ever occurred in this country, with an attendance of about 5,000 men and women of science, drawn from the whole of English-speaking North America. A brief summary of the notable advances reported in science during 1928 will appear in the next issue of NATURAL HISTORY.

SCIENCE OF MAN

EASTER ISLAND STONE FISH HOOKS.—Easter Island is a land of mystery and romance, and anything that hails from its shores has unusual interest. Recently the department of anthropology received from Charles Nordhoff of Papeete, Tahiti, a fish hook made of stone used by the natives of this island. The hook is a unique specimen of primitive stone work not heretofore represented in the Museum's collection. It is exquisitely finished and in every way a fine example of Easter Island art. Some time ago Doctor Gudger of the department of fishes made a detailed study of the Museum's collection of fish hooks from the islands of the Pacific Ocean, which appeared in the *Anthropological Papers*. This publication attracted a great deal of attention, especially among students of primitive and prehistoric fishing in the South Sea Islands, and encouraged them to take up new investigations. Mr. Nordhoff is making a detailed study of fishing among the natives of the Society Islands, and coöperating with Doctor Gudger in determining the distribution of fishes in the Pacific Ocean. The Museum is indebted to Mr. Nordhoff, not only for the gift noted above, but for many past courtesies.—C. W.

AFRICAN WOOD CARVINGS FOR THE AMERICAN MUSEUM COLLECTIONS.—Mr. George D. Pratt has presented to the Museum some wooden statuettes and a bronze casting made by the Negroes of west Africa. Native African carving in wood and ivory is recognized as one of the world's most characteristic types of art. While it is true that a certain grotesqueness pervades African carvings, yet there is symmetry and beauty of form. The educated Negroes of America are taking an intelligent interest in this art as a part of the æsthetic heritage of their race. The Museum now has collections from the Congo and adjacent parts of Africa in which wood carving is well represented.—C. W.

THE MUSEUM ACQUIRES IMPORTANT SERIES OF ESKIMO HAIR SAMPLES.—Among other interesting materials brought back by Mr. Edward M. Weyer, Jr., archæologist on the Stoll-McCracken Expedition, are a series of measurements of one hundred Eskimo men. In addition he was equipped with a set of Binet tests by which their mental rating could be made. This is probably the first attempt to apply a series of such tests to an adult Eskimo. That Mr. Weyer is a diplomat when among such people is further indicated by a complete collection of hair samples. According to Eskimo belief, giving away a lock of one's hair puts one in the power of the recipient. Consequently, asking an Eskimo for a lock of hair is about the equivalent of asking him for his life. Nevertheless, Mr. Weyer convinced them that he could be trusted and so came away with a full series of hair samples. These samples are an important addition to the Museum's collection, in which is

to be found authentic hair samples from different races of the world. Such a collection is important, because hair is one of the outstanding racial characteristics, a character in which there is the least variation and, therefore, one of the best characters by which to make classifications of racial types.—C. W.

MASKS MADE OF WHALE BONES DISCOVERED ON THE ALASKAN PENINSULA.—The recently returned Stoll-McCracken Alaskan Expedition brought two unique masks carved from bones of whales. These masks were found by Edward M. Weyer, Jr., archæologist of the expedition, while digging in a shell-heap on the Alaskan Peninsula. No masks made of whale bones have been reported, and while it seems likely that these were made by an Eskimo people, they were in a deep deposit and so of considerable age. They also show a high degree of workmanship and unusual symmetry of form.—C. W.

ALEUTIAN BURIALS.—In a recent number of NATURAL HISTORY appeared an article on the Aleut of the Aleutian Islands in which, among other information about their daily lives, was an account of the peculiar way in which they used to prepare their dead for burial. The Stoll-McCracken Expedition discovered such a burial on a small rocky island of the Aleutian chain. The tomb was constructed with logs carefully fitted together and enclosing three bodies. Two of the bodies are well preserved like mummies enclosed in wrappings. Most unique of all is the head of one body found in a fine condition, fully equal to that of the best Egyptian mummies. These Aleutian mummies have been placed on exhibition in the Museum and the discovery of this tomb is important in that it gives us complete information as to the mode of burial formerly practiced by these natives. Also, the costumes and other objects accompanying the mummies will give data as to the weaving and tailoring arts of the Aleutians. The idea of the Aleuts was to keep the dead with them as long as possible, so the bodies were preserved as well as they knew how. The procedure in brief outline was to open the abdomen, remove the viscera, close the body, and then wrap the whole in skins. Prepared in this way, the flesh dries hard and a true mummy results. Ultimately, these bundle bodies were placed in dry caves in the rocks or in tombs built of logs, as was the case in this instance.—C. W.

CHARLES SHELDON

In the death of Charles Sheldon, on the 23d of September, 1928, the country loses one of its foremost conservationists and the Boone and Crockett Club one of its most active members.

Charles Sheldon, after graduating from Yale in 1890, spent four years in Mexico in the railroad business. During this time he made many hunting trips into the least known parts of that country and acquired an extensive first-hand knowledge of its wild life. Returning to the United States, he decided to devote his time to exploration and hunting in Alaska and Mexico, with especial reference to the distribution of the various species of mountain sheep. He first went to Alaska in 1902 and in the following years explored the mountains of southeastern Alaska and the adjoining parts of British Columbia, where he hunted in the Cassiar Mountains and the ranges lying to the north. In pursuit of his favorite study of the big horn sheep, he passed an entire winter on the northern slopes of Mt. McKinley, and he later hunted in company with Frederick Courtney Selous in the headwaters of the Lewes and Hootalinqua Rivers.

The specimens he secured in these hunting trips he forwarded to the National Museum at Washington, where he worked in close coöperation with C. Hart Merriam and E. W. Nelson. The results of all these expeditions to Alaska and British Columbia have been embodied in a series of books, the best known of which were entitled, *The Wilderness of the Upper Yukon* and *The Wilderness of the North Pacific Coast Islands*, 1912.

After his marriage in 1909 to Miss Louise Gulliver, he settled down in Washington, D. C., spending his summers in Nova Scotia and making occasional trips to his old hunting grounds. He devoted himself to the interests of the Boone and Crockett Club, of which he was First Vice-President at the time of his death. For many years he represented the interests of this club at Washington.

He developed the laws of game conservation along the European ideas of administration of game. In this matter he was in advance of his countrymen, since, as yet, few of them realize the necessity of "administrating" game as it is done in Europe. The reckless depletion of our game supply will soon force all Americans to accept his views on this subject.

Much of Mr. Sheldon's time in recent years has been devoted to the collection of a library which is absolutely unique in the field of hunting and conservation. This collection of books represents a large outlay and should be kept as a unit. Efforts to accomplish this end are being made by his friends.

Mr. Sheldon's death occurred suddenly in his camp in Nova Scotia.—MADISON GRANT.

PETER SUSHKIN

THE ACADEMY OF SCIENCES in Leningrad announces the sad news of the death of Prof. Peter Sushkin on September 17, 1928, at Kislovodsk, Caucasus. A special celebration had previously been planned for October in honor of Professor Sushkin's fortieth year of scientific research and educational activity. The American Museum of Natural History shares in the deep sorrow at the passing of this eminent ornithologist and palæontologist.

CHARLES H. GARDNER

In the death. on December 7, of Charles H. Gardner, a Vice-President and Manager of the 79th Street Branch of the Colonial Bank, American Museum employees have lost a friend who for more than twenty-five years gave them his most helpful assistance, and the Corporation has lost one ever willing to serve it. No appeal for his experienced judgment was ever denied and none ever found him other than considerate and courteous.

Mr. Gardner's kindly attitude and genial personality made for him a large circle of friends who greatly deplore his sudden and unexpected death.

LOUIS AGASSIZ FUERTES IN MEMORIAM

February 7, 1929, marks the 55th birthday anniversary of Louis Agassiz Fuertes, whose untimely death by accident at a railroad crossing near Unadilla, New York, on August 22, 1927, brought to a close an unusual career as one of the leading bird-life painters of the world.

He has created well, since we partake
Of countless treasures here that bear his mark.
For him there is no terror in the dark:
Where soon the throbbing, golden dawn will break.
His feathered friends that with tomorrow wake
And sing their hearts away:—the meadow-lark,
The thrush, the chickadee, with song embark
Upon their journey, though their throats must ache
With dismal longing, since he hears them not.
Grant that he rest within some silent spot
Beloved by him, when evening shadows fall:
A garden filled with flowers, moss, and grass,
Where he can hear the autumn winds that pass
And spattered rain upon an ivied wall.
So will he dreamless sleep, and well-content,—
With bird and tree for earthly monument.

—MARGUERITE JANVRIN ADAMS.

BOOK REVIEWS

Coming of Age in Samoa, by Margaret Mead, Ph.D. William Morrow, New York City, 1928.

Dr. Margaret Mead, associate curator of ethnology in the American Museum, is now on her way to the South Pacific to continue her studies of adolescent girls among the native populations. Recently she brought out a book *Coming of Age in Samoa*, presenting some aspects of her earlier studies along this line among the Samoans. Some thirty or more years ago, the late G. Stanley Hall led a movement in this country for the study of adolescence as the critical transition period in life. According to the conception of the time, the adolescent period was regarded as the critical stage in the individual's development, especially with respect to morals, religion, and general social adjustments. From that time to this our own youth have been studied intensively, more intensively than in any other country. So far, however, little attention has been paid to the comparative study of adolescence among other types of civilization and among primitive peoples. Doctor Mead's book is therefore a welcome contribution, since it gives us for the first time a picture of adolescence in a primitive tribe. The author presents clearly and directly the main features in the life of the adolescent girl in Samoa, as well as the social setting in which she must find her way. The author sees a sharp contrast between the situation confronting the Samoan adolescent girl and that confronting our own children, a situation due in large part to the simple, easy-going life of the Samoan. Doctor Mead believes that the adolescent who has trouble in adjusting herself to Samoan society is the exceptional girl who is ambitious to be recognized by her elders and to achieve something worth while, whereas the ideal of Samoan civilization seems to be an easy-going, complacent life, accepting conditions as they come. In our own society, the author believes that the reverse is true, that the adolescent who is so complacent that nothing much matters is the one that gets into trouble and develops a case of maladjustment. However this may be, the thoughtful adult will find the book provacative of reflection upon the more intimate aspects of life.—CLARK WISSLER.

"BLAZING THE TRAIL TO THE DISTANT PAST"

The cover design for this number of NATURAL HISTORY is reproduced from another painting by Mr. Arthur A. Jansson of the American Museum staff, and represents a party of palæontologists uncovering a fossil skull of the dinosaur *Tyrannosaurus*. In the distance, outlined against the sky, is the artist's conception of what these scientists are able to visualize as they struggle with the huge fossil skull. *Tyrannosaurus* was, during the Cretaceous period, the most terrible of all the "terrible lizards"—a beast of prey before whom even *Triceratops*, the greatest of the horned dinosaurs, probably fell. *Tyrannosaurus* attained a length of about thirty-five feet, and was surpassed in size by other creatures, but no other dinosaur yet discovered had such powerful jaws and teeth.

OUR CONTRIBUTORS

Young aspirants to the art of palæontology will be interested to know that in the year 1876 **Henry Fairfield Osborn**, the author of "The Revival of Central Asiatic Life," began hunting invertebrate fossils in the Palæozoic beyond the Catskill Mountains; in 1877 and 1878 he was chosen leader of a party of Princeton students in a hunt for fossil vertebrates in Wyoming, and between these two expeditions he worked very hard cleaning and preparing and illustrating fossils. In 1890 after several years' research in comparative anatomy, he resumed fossil cleaning and preparing and describing in the top of an old elevator shaft of the American Museum with Doctor Wortman, and thus with a handful of fossils from the Wasatch Mountains was established the Department of Vertebrate Palæontology which, with the cooperation of a series of great fossil explorers—Wortman, Granger, Brown, Peterson, Gidley, Kaisen, Olsen—is filling the six great exhibition halls of our Museum and rewriting the palæontological history of the world. Meanwhile hundreds of pamphlets, bulletins, and volumes were issued describing these fossils, including in 1890 a prediction regarding the ancient fossil life of Central Asia, which has been brilliantly verified by Andrews and Granger as partly described in the present article.

Henry Field, author of "Early Man in North Arabia," is one of the most promising recruits in the younger school of American archæologists who are specializing in the Old Stone Age of western Europe. Beginning his original archæological studies in England, France, and Spain, he is now extending his work into the Near East, Palestine, and Syria, which promise to form the connecting half-way point between the European and Central Asiatic archæology of the Stone Age. The Field Museum of Chicago, now under the acting direction of Stanley Field, has entrusted to Henry Field the design and arrangement of the entirely unique exhibition hall in which the various phases of the Stone Age are shown somewhat after the manner of the habitat groups of zoologists. NATURAL HISTORY is indebted to the Field Museum for the opportunity of publishing the present narrative of Henry Field's reconnaisance in Syria.

H. E. Anthony, who tells of the quest of the Schooner "Morissey" to the Arctic for walrus, and how, homeward bound, she beat the ice packs crowding down from the Polar Seas, has traveled more than 100,000 miles on expeditions in North, South, and Central America, the West Indies, Africa and the Arctic. Mr. Anthony began collecting mammals while he was still in high school, and he had more than 1500 specimens before his association with museums left him no further time for private collecting. His first trip for the American Museum took him to Lower California with Dr. C. H. Townsend in 1911. Since that time he has been a member of the department of mammals of the world at the American Museum. He is the author of *A Field Book of North American Mammals*, as well as a frequent contributor to NATURAL HISTORY.

Dr. Chester A. Reeds is familiar to the readers of NATURAL HISTORY, through the many fascinating and instructive articles on geology and fossil invertebrates that he has contributed for many years. "When Winter Comes" is cramfull of information about such everyday things as how snow, ice, sleet, hail, and frost are formed.

Wilmatte Porter Cockerell has accompanied her husband, Prof. T. D. A. Cockerell of Boulder, Colorado, on countless expeditions through many strange lands, and her experiences have been presented to the public in lectures and articles. She has done much original research work in botany and with Prof. Cockerell, developed a new species of sunflower in her sunflower garden at Boulder in 1910. Her article in this issue of NATURAL HISTORY entitled "New Caledonia—A Fragment of the Ancient World" will interest many of our readers who like to study every angle of the history of this old world of ours.

Dr. Clyde Fisher's practical experience in the schools of Ohio and Florida, his training at Johns Hopkins University where he received his doctorate in botany, together with his enthusiasm as a teacher, have developed to a high degree his natural, rare talent of stimulating interest, and imparting knowledge to young people. He has been a member of the education department of the American Museum for fourteen years, and has rendered exceptional service in promoting the growth of the Museum's methods of visual instruction. His article "How Nature Plants Her Flowers" is a charming example of his method of sharing his wealth of botanical knowledge.

The group of insects which includes flies and mosquitoes and which contains more than twice as many species as there are vertebrates, including birds and fishes, has been a subject for particular research on the part of **C. H. Curran**, assistant curator in charge of Diptera, at the American Museum. He tells in "Mosquitoes and Other Flies" of some of the strange habits of these common insects, as well as of the remarkable forms and beauty with which they are sometimes endowed. Mr. Curran came to the Museum from the entomological branch of the Department of Agriculture, Ottawa.

Observations made during eight years in the Indo-Australian region form the basis of the present article on "Strange Animals of the Island Continent" and of other articles which **Henry C. Raven** has contributed to NATURAL HISTORY. Mr. Raven, who is associate curator of the department of comparative and human anatomy at the American Museum, has done extensive zoological field work in the Dutch East Indies, Africa, Australia, and Greenland.

Of all the gallant companions of Roald Amundsen on that now historic airplane flight to the Pole in 1925, and the Transpolar Flight of the dirigible Norge in 1926, from Spitzbergen to Alaska, no one held a deeper or more lasting friendship for the great Explorer than did **Lincoln Ellsworth**. His tribute to the sterling qualities of this heroic personality of the world's famous polar explorations appears in this issue under the title "Roald Amundsen."

William G. Hassler, a new contributor to NATURAL HISTORY, originally planned to perfect himself in electrical engineering. He spent his summers at the Boy Scout Camp at Bear Mountain, and became so interested in studying the reptiles and amphibians of that region that his knowledge of these creatures soon fitted him for a position on the camp staff. Later he was invited to affiliate himself with the department of herpetology and experimental biology at the American Museum, where the care of the live reptile material is his responsibility, together with the preservation and supervision of the study collections of that department. Some of his experiences in hunting salamanders are told in "Salamanders of the Great Smokies."

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total number 10,893.

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